AFIT/GE/ENG/99M-18

TERRAIN BACKSCATTERING COEFFICIENT GENERATOR

THESIS

Ricardo Mediavilla, Second Lieutenant, USAF
AFIT/GE/ENG/99M-18

19990413 093

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	March 1999	Master's Thesis

4. TITLE AND SUBTITLE
TERRAIN BACKSCATTERING COEFFICIENT GENERATOR

5. FUNDING NUMBERS

6. AUTHOR(S)
Ricardo Mediavilla, Second Lieutenant, USAF

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Air Force Institute of Technology
2950 P ST.
WPAFB OH 45433-7765

8. PERFORMING ORGANIZATION REPORT NUMBER
AFIT/GE/ENG/99M-18

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Capt. Kelce S. Wilson
AFRL/SNAS
2010 Fifth Street Bldg. 23, Area B
Wright-Patterson AFB, OH 45433

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Advisor: Dr. Vittal P. Pyati
Phone:785-3636 x4576
Email:Vittal.Pyati@afit.af.mil

12a. DISTRIBUTION AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Using already available data, a backscattering coefficient generator (BCG) for several types of terrain and measurement conditions is developed. The types of terrain are 1) soils and rocks, 2) trees, 3) grasses, 4) shrubs, 5) short vegetation, 6) roads, 7) urban areas, 8) dry snow, and 9) wet snow. These data sets typically cover incidence angles ranging between 0 and 80 degrees where 0 is normal to the terrain. Measurement conditions are defined by 1) incidence angle, 2) wave polarizations configuration (HH, HV, or VV), and 3) radar band (L, C, S, X, Ku, Ka, or W).

The BCG output matches very closely the first and second moments of the published data. A modified chi-square goodness of fit test at a 0.05 significance level is introduced to automatically validate the generated output with measured data histograms. The BCG reproduces 100% of measured mean backscattering coefficient (BC) and standard deviation values. The modified validation test failed to reject the BCG output as representative of the measured data for 72% of simulated distributions having a database-source-point number (N) greater than 100. Noted discrepancies can be attributed to sparse BC data histograms and BCG limitations at incidence angles less than 20 degrees for certain terrain types.

14. SUBJECT TERMS
Backscattering Coefficient, Ground Clutter, Chi-square.

15. NUMBER OF PAGES
87

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UL

AFIT/GE/ENG/99M-18

TERRAIN BACKSCATTERING COEFFICIENT GENERATOR

THESIS

Presented to the Faculty of the Graduate School of Engineering

Of the Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Electrical Engineering

Ricardo Mediavilla, BS

Second Lieutenant, USAF

March 1999

AFIT/GE/ENG/99M-18

TERRAIN BACKSCATTERING COEFFICIENT GENERATOR

Ricardo Mediavilla, BS

Second Lieutenant, USAF

Approved:

Vittal P. Pyati ____________________ 3 Mar 99

Dr. Vittal P. Pyati
Committee Chairman
Date

Michael A. Temple ____________________ 3 Mar 99

Maj Michael A. Temple, Ph.D.
Committee Member
Date

____________________ 3/3/99

Dr. Andrew J. Terzuoli
Committee Member
Date

Preface

This research proposes a simple backscattering coefficient (σ^o) generator for several radar bands, types of terrain, and wave polarizations for angles of incidence up to 80^0. The generator is based on an extensive database of σ^o measurements [8]. This generator was first proposed and successfully used by Wilson for nine terrain types, X-band radar, and VV polarization [11].

This research expands the generator's capabilities by adding six radar bands and the three types of wave polarizations (HH, HV and VV) for all nine terrain types. A method to automate validation of the generated distributions based on a modified chi-square test was developed.

Parallel to this research effort is the work of O'Connor (to be published). The mentioned research successfully applied modified sea clutter models to extend the measured σ^o curves to the grazing angle region ($\theta > 80^o$). The "production" σ^o generator features this improved grazing angle simulation capability.

I want to thank Capt. Kelce Wilson for the invaluable help to create a tool that will find good use among the people interested in backscattering coefficient measurements.

Acknowledgments

I would like to wholeheartedly thank my thesis committee for their support, ideas, and suggestions along the way: Dr. Vittal Pyati, Maj. Mike Temple, Dr. Andrew Terzuoli, and my sponsor, Capt. Kelce Wilson. A thanks goes to all supporting personnel at the Air Force Institute of Technology. These individuals made possible this research. Thanks to all friends who have made this experience a good one every day. Special thanks to my wife, Paola, for her comprehension and care through this intense journey. Blessed be our Father in Heaven for all his help.

Ricardo Mediavilla

Table of Contents

List of Figures

Figure

AFIT/GE/ENG/99M-18

Abstract

Using already available data, a backscattering coefficient (σ^{o}) generator for several types of terrain and measurement conditions is developed. The types of terrain are 1) soils and rocks, 2) trees, 3) grasses, 4) shrubs, 5) short vegetation, 6) roads, 7) urban areas, 8) dry snow, and 9) wet snow. These data sets typically cover incidence angles ranging between 0^{o} and 80^{o} where 0^{o} is normal to the terrain. Measurement conditions are defined by 1) incidence angle, 2) wave polarizations configuration (HH, HV, or VV), and 3) radar band (L, C, S, X, Ku, Ka, or W). The σ^{o} generator output matches very closely the first and second moments of the published data.

A modified chi-square goodness of fit test at a 0.05 significance level is introduced to automatically validate the generated output with measured data histograms. Contrary to an ordinary chi-square test previously applied, the modified test rejection rate was consistent with expected behavior of simulated and measured data graphs as the number of source data points (N) increased. The modified test failed to reject the proposed generator as representative of the measured data for an average 72% of all simulated distributions having $N \geq 100$. Noted discrepancies can be attributed to sparse σ^{o} data histograms and model limitations in the $0^{o} \leq \theta \leq 20^{o}$ for certain terrain types.

The σ^{o} generator is a realistic simulation tool of terrain backscattering statistics since it portrays terrain's true probabilistic nature.

TERRAIN BACKSCATTERING COEFFICIENT GENERATOR

I. Introduction

Background

The backscattering coefficient (σ^o) is a measure of the electromagnetic energy scattered from a distributed target in the receiver direction. In general, σ^o is dependent upon target shape, degree of roughness, dielectric constant, viewing geometry, scattering center location, and the attributes of the transmitted and scattered electromagnetic waves (wavelength, polarization, and incidence angle) [8]. In this research, the backscattered energy from a terrain patch of definite area is of interest.

The scattering centers of a terrain patch are randomly distributed and vary in position with frequency and incidence angle [8]. These characteristics give σ^o its random quality. The reader can envision such an effect by placing some glitter on a piece of paper. When illuminated, it will become evident that at any specific "look-angle" only certain glitter grains flicker. These "scattering centers" on the piece of paper contribute to the paper's "σ^o". These σ^o characteristics justify its description as a mean value calculated upon several measurements at an incidence angle, frequency, and wave polarization. These will be referred as *measurement conditions*. The value of σ^o is also influenced by seasonal variations of vegetation biomass [8]. This inherent dependence of σ^o on terrain characteristics has found generalized use as indicator of crop maturity, terrain humidity, and other uses.

The potential applications of σ^o have motivated numerous studies and papers dealing with its measurement and theoretical models. Measurement of σ^o has been a tough task because of the randomness of the process itself, as well, as the calibration issues involved. Early efforts by Ohio State University and other research groups focused mainly in the $10^o \leq \theta \leq 80^o$ where θ (incidence angle) is measured from normal incidence. Experiments to collect σ^o data at grazing angles ($80^o \leq \theta \leq 90^o$) are very scarce [7]. Nevertheless, the measurement of σ^o has become an active area of radar research because of its potential military and environmental applications. Military applications arising from the theory and measurements of σ^o focus in the development of accurate target recognition techniques. Environment sensing applications are being applied to optimize the use of natural resources.

In this research, the measured σ^o data source is the *Handbook of Radar Scattering Statistics for Terrain* [8]. This book features a comprehensive database of σ^o measurements for several types of terrain and measurement conditions. These data measurements were collected from several studies spanning several years and intents. The database portrays the statistical properties of σ^o measurements as a mean σ^o and associated $s(\theta)$. Frequencies of occurrence histograms describe the distribution of the σ^o values. The classifications for terrain are: (1) soil and rock surfaces, (2) trees, (3) grasses, (4) shrubs, (5) short vegetation, (6) roads, (7) urban areas, (8) dry snow, and (9) wet snow. The conditions for data inclusion into the database are comprehensive and well explained in Chapter V of the mentioned reference [8:79].

This research proposes a σ^o generator that is constructed upon the compiled data in [8]. The user of the σ^o generator must specify (1) type of terrain, (2) wave polarization, (3) incidence angle, (4) radar band, and (5) a $U(0,1)$ random variable. These will be called *generator input set* (GIS). The generator produces a value of σ^o in decibels. Note that to obtain the published mean σ^o and $s(\theta)$ for a GIS, sufficient σ^o values must be generated.

In his doctoral dissertation, Wilson first proposed and used a prototype σ^o generator for all types of terrain listed above but limited to X-band and VV polarization [11]. This research applies previously established concepts to expand the generator's capabilities to include nine terrain types (described above), six additional radar bands, and the full set of linear wave polarizations, namely horizontal-horizontal (HH), horizontal-vertical (HV), and vertical-vertical (VV). The generator output is tested for goodness-of-fit against the measured data available using a chi-square hypothesis test with encouraging results.

Problem Statement

Develop a backscattering coefficient (σ^o) generator that will emulate measured σ^o data. The σ^o generator should be designed with a minimum 1^o angular resolution. The generator output statistics should match the first and second moments of the published data in [8] when a sufficient number of samples are generated. The generator should output σ^o values for all three pairs of linear polarizations, seven radar bands, and nine types of terrain. Generated ouput distributions should be similar to the frequency of occurrence histograms of measured data. Validate generated distributions using a chi-square goodness-of-fit test for all incidence angles where data exists. Generator should

be autonomous such that new σ^{o} data and generated histogram validation may be done with minimum user interaction.

Scope

Limit data to the aforementioned nine terrain types, seven radar bands, and the full set of linear polarizations, as tabulated in [8]. The σ^{o} generator algorithm should be coded in FORTRAN.

Assumptions

It is assumed that the database in [7] is accurate.

General Approach

The σ^{o} generating function is defined by

$$\sigma = \beta \cdot \left(-\ln(U)^{\alpha}\right) + \gamma \tag{1}$$

where β is an amplitude term, α is a skewness parameter, γ is a distribution adjustment quantity, and U is a uniform $U(0,1)$ random variable. The mean of the function over an ensemble of $U(0,1)$ random numbers in (1) represents the mean σ^{o}, while its standard deviation represents the standard deviation of the mean σ^{o}, namely $s(\theta)$.

The mean σ^{o} and $s(\theta)$ values contained in [8:119-356] are typically provided in angular increments of 5 and 10 degrees. A method of interpolation by cubic splines is applied to the data to achieve the required 1^{o} angular resolution. Cubic spline interpolation was chosen on the basis of smoothness and its inherent ability to connect all measured data points.

The α, β, and γ values are selected such that all interpolated values of the mean σ^{o} and $s(\theta)$ sequences can be generated by (1). An optimization algorithm is used to

determine which α–β combination (for a fixed γ value) generates the desired σ^o and s(θ) with minimum error. The generated distributions are tested for goodness-of-fit using a chi-square test. If a generated distribution is rejected, parameter γ is either increased or decreased to adjust the output histogram of (1) such that it fits the measured data histograms satisfactorily. Manipulation of γ has some practical limitations that are discussed in Chapter IV.

Sequence of Presentation

A literature review about σ^o and its statistical models and a brief description of some of its applications take place in Chapter II. A description of Equation (1) will be given in Chapter III. The algorithms used to find the appropriate α–β sets are developed and explained in this chapter. Presentation and analysis of the results follow in Chapter IV. To end this journey, conclusions and recommendations are given in Chapter V.

II. Literature Review

In the early years of radar development, it became evident that unwanted clutter originating from electromagnetic waves echoing back from terrain and sea needed to be accounted for in radar system design. Efforts to quantify clutter and its characteristics support radar systems engineering and more recently, aid in the monitoring of terrestrial phenomena.

Backscattering Coefficient (σ^0)

The radar range equation describes the relationship between the transmitted power P_t to a point target at a range R and the power P_r detected by the radar receiver [7]

$$P_r = \frac{P_t G_t}{4\pi R^2} \cdot \frac{\sigma_{RCS}}{4\pi R^2} \cdot A_e \tag{2}$$

The quantities G_t and A_e represent the transmitting antenna gain and the receiving antenna's effective aperture area, respectively. The quantity σ_{RCS} is the target's radar cross section (RCS) in units of meter squared (m^2).

The RCS of a target depends on radar system characteristics such as direction of illumination, wavelength, and polarization [7]. Also, a target's RCS depend on the complex permmitivity, degree of roughness, and viewing geometry. In mathematical terms, the RCS is defined as [8]

$$\sigma_{pq} = \lim_{R\to\infty}\left(4 \cdot \pi \cdot R^2 \frac{S_p^s}{S_q^i}\right) \tag{3}$$

where the subscript p and q refer to the polarization of the scattered and incident waves, respectively. The quantity R is the radar to target distance. S_p^s and S_q^i are the scattered and incident power densities, respectively. The scattered power density (numerator of

equation) varies as R^{-2}, rendering Equation (3) independent of range [7]. The limit notation denotes that the RCS is a far field quantity. The set of linear polarizations (HH, HV, and VV) is used to be consistent with the convention in [8].

By using the relationship

$$S = \frac{|E|^2}{\eta} \tag{4a}$$

where η is the air impedance and E is the electric field intensity, we have

$$\sigma_{pq} = \lim_{R\to\infty}\left(4\cdot\pi\cdot R^2 \frac{\left|E_p^s\right|^2}{\left|E_q^i\right|^2}\right) \tag{4b}$$

where p and q are substituted by HH, HV, or VV as appropriate. Note the reciprocity in the terrain backscattering process for HV and VH polarizations [8]

$$\sigma_{hv}^o = \sigma_{vh}^o \tag{5}$$

A more convenient measure of RCS for distributed targets is the backscattering coefficient, σ^o, defined as [8]

$$\sigma_{pq}^o = \frac{\sigma_{RCS}}{A} \tag{6}$$

where A is the area covered by the antenna's footprint on a reasonably flat surface [10]. This causes σ^o to be independent of the radar's geometric parameters (pulse width, beamwidth, etc.) [7]. In this research, the definition of σ^o as in Equation (6) will be used (Figure 1).

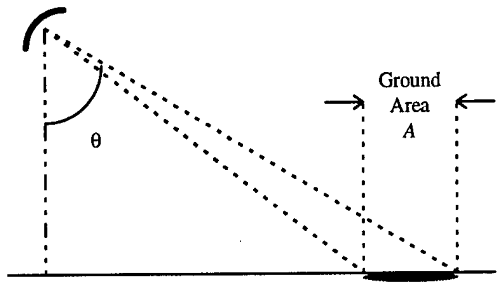

Figure 1. Data collection geometry.

Scattering Mechanisms

Several theories attempt to explain the interaction of electromagnetic waves and terrain. Although a thorough discussion of these is out of the scope of this document, the facet theory of scattering will be briefly described.

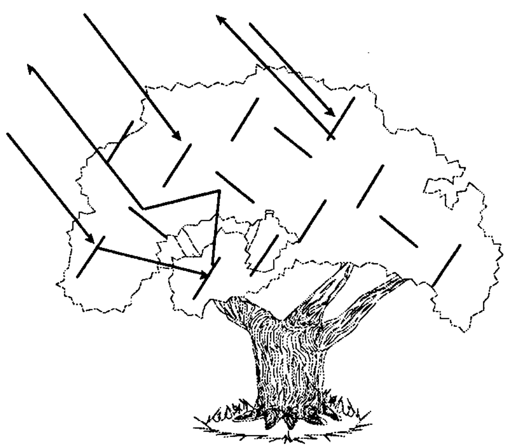

Figure 2. Simplified facet scattering model.

This theory models an object by a number of facets tangential to the object's surface. The centers of the facets constitute scattering centers. The total scattering is computed by determining the re-radiation patterns and slope of each facet. Figure 2 displays a highly simplified facet model for a tree canopy. The facets can be large or small relative to wavelength. As the wavelength increases, a given facet will change from large to small. The overall effect of the increase in wavelength is the apparent smoothening of the surface. When the transmitted signal is narrow-band and coherent, the received signal will be the phasor sum of each facet (or scatterer) contribution [7].

Dependence of σ^o on Terrain Characteristics

The σ^o values for a distributed target are determined by its electromagnetic and physical attributes. The σ^o of a co-polarized scatter (HH and VV) exhibits three distinct regions, namely "quasy-specular", "plateau" region, and a "shadow" region (Figure 3). In general, the σ^o of a cross-polarized scatter (HV) does not exhibit the same distinct regions as the co-polarized scatter [7]. The most important details about σ^o response based on terrain characteristics will now be summarized. This summary will follow [8] closely.

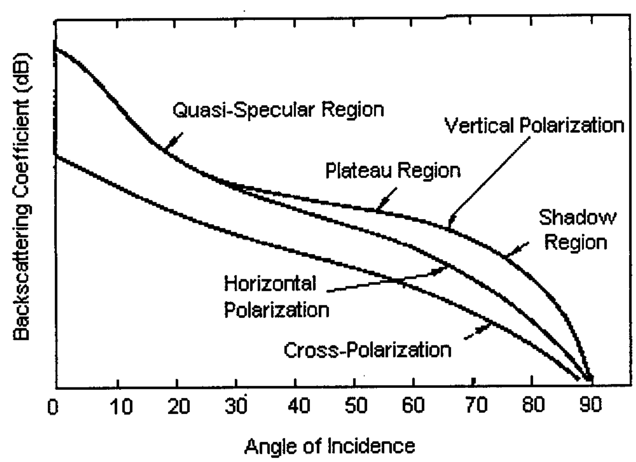

Figure 3. Typical σ^o Curves [8].

For smooth surfaces, the σ^o exhibits a strong return in the quasi-specular region that decays rapidly as the angle of incidence, θ, increases. For rough surfaces, the change in σ^o as θ increases is of much smaller magnitude. Generally, the σ^o curve exhibits a slight negative slope [7].

Terrain moisture greatly influences the amount of scattered energy. For a distributed target, the value of σ^o increases as the moisture content increases and viceversa [8]. This is a consequence of the larger microwave dielectric constant of water relative to that of the holding surface. This property has been useful as a terrain humidity indicator. For instance, a study at the Freiburg test site, Upper Rhine Valley, Germany

showed strong positive correlation between σ^o and soil moisture content at microwave frequencies [6]. A satellite-based system was used to measure σ^o.

For the most part, surfaces covered by vegetation have a σ^o response mainly due to the canopy, and to a lesser degree, to the underlying soil. As the vegetation canopy thins, the σ^o contribution from the soil increases, changing σ^o [7]. The thinning of vegetation decreases the σ^o response of a distributed target. A case in point is a study of Les Landes Forest, France (L band) [2]. This study showed that forest thinning contributed to σ^o reduction of up to 4 dB, most noticeably for HV polarization. Thinning involves decreasing tree population, which induces a change in mean tree height and a change in the trunk diameter distribution. Also, thinning causes canopy structure modifications such as rearrangement of tree's crowns and the clearing of vegetation above ground level. The authors theorize that this could be responsible for the σ^o decrease.

Snow exhibits a σ^o signature that changes with the observation wavelength. If the wavelength is large compared to the internal structure of the snow layer (such as L band), the σ^o will be largely from the underlying soil. This changes as the wavelength becomes smaller (Ka band). The σ^o response will resemble that of a rough surface since the snow structure becomes the main source of backscatter. Moisture also has a significant impact on snow's σ^o. For two samples of snow of differing moisture content, the σ^o response will be stronger for the drier sample as the wavelength increases. This difference is greatest at small wavelengths (Ka band) [8].

Urban areas are hard to describe using σ^o since many structures in such an environment have deterministic shapes that can behave as strong point targets [7]. These

point targets scatter energy that dominates over the total scattered energy from all other scatterers present. The theory to handle this situation is different to that of other terrain types. For example, a recent study of the urban characteristics of Sydney, Australia computed theoretical σ^o signatures from urban areas using deterministic methods [4]. This investigation identified single bounce scattering from surfaces such as roofs, double bounce from ground-wall structures, and other metallic elements as principal radar scattering contributors. A better understanding of urban area scattering will enable monitoring and precise classification of such areas.

Other method to quantify scattering from urban areas is to measure the σ^o response of an urban conglomerate and average the return over wide areas. Then, the scanned areas could be classified as residential, commercial, or industrial [7].

Statistics of Ground Clutter

Most clutter theories assume that a patch of terrain is large enough to contain a significant number of randomly localized scatterers [7]. These scatterers produce a signal at the receiver whose envelope behaves like random noise due to fading effects. (Fading refers to the wide variations in the received signal's envelope due to phase-shift changes; in turn, these are caused by look-angle changes relative to the illuminated area due to platform movement.) Therefore, the statistics of random noise can be used to model the scattered signal being received, namely, the Rayleigh clutter model [7].

The application of the Rayleigh clutter model is based on a set of assumptions discussed in [8] and reviewed here for convenience:

(1) It is assumed that the individual scatterers are independent of each other. Any interactions between adjacent scatterers is ignored. Hence, the total instantaneous electric field is expressed as the sum of each scattered electric field.

(2) The maximum extent of the target under scrutiny is much smaller than the mean range from the antenna to the target. The antenna is assumed to have uniform gain across the target area.

(3) As stated before, a distributed target contains a large number of scatterers. The amplitude and phases of the scattered electric fields are considered independent. This last condition is satisfied by having the scatterers randomly distributed across the target's area. At least ten scatterers are necessary to ensure that the orthogonal components of the electric field are normally distributed [8].

(4) The phase must be randomly distributed between $[0, 2\pi]$. This can be accomplished by choosing the target's extent to be several wavelengths across. The target is also assumed to have randomly located scatterers.

(5) No single scatterering center produces an electric field intensity that dominates the total scattered field from the distributed target.

These assumptions lead to the Rayleigh clutter model:

$$f(E_e) = \frac{E_e}{s(\theta)^2} e^{\frac{-E_e^2}{2s(\theta)^2}}$$

$$f(\phi) = \frac{1}{2\pi} \qquad\qquad 0 \leq \phi \leq 2\pi \tag{7}$$

$$\overline{E_e} = \left(\frac{\pi}{2}\right)^2 s(\theta)$$

where $f(E_e)$ is the probability density function (PDF) of the total electric field magnitude before detection at the receiver. The second equation, $f(\phi)$ is the PDF for the phase, while $\overline{E}_e$ denotes the average value of E_e. The variance of E_e is denoted by $s(\theta)^2$ and the standard deviation , s(θ), is just the square root of the variance.

The Rayleigh clutter model may not be applicable to forest or urban scenes where some scatterers may dominate the return at certain frequencies and incidence angles [8]. The Ricean PDF is used when one or a few strong scatterers exist within the observed target. Other PDF models that are often used include the Weibull and log-normal.

<u>Approximate σ^o Models</u>

In this section, the various theoretical and empirical models published by several σ^o studies will be explained.

The following set of equations describes behavior of σ^o of the combined observations of space station Skylab's radiometer-scatterometer (RADSCAT) and University of Kansas' truck mounted microwave active spectrometer (MAS).

The model is representative of summer conditions averaged all over North America:

$$\sigma^o_{dB}(f,\theta) = A + B\cdot\theta + C\cdot f + D\cdot f\cdot\theta \qquad 20^\circ \le \theta \le 70^\circ$$

$$\sigma^o_{dB}(f,\theta) = M(\theta) + N(\theta)\cdot f \qquad \theta = 0^\circ, 10^\circ$$

where f is the frequency and θ is the incidence angle. The indicated range of incidence angles for both equations determines the values of the A, B, C, D, M, and N coefficients. The loading parameters for both equations can be found in [8]. The σ^o value for an incidence angle $0^\circ < \theta < 10^\circ$ and $10^\circ < \theta < 20^\circ$ is found by interpolating the resulting curve.

Several studies have investigated the potential applications of radar for moisture sensing of vegetation covered soils. The following model represents the σ^o response of a soil surface covered by vegetation [9]:

$$\sigma^o = T^2\cdot\sigma^o_s + \sigma^o_{dv} + \sigma^o_{\text{int}}$$

where T^2 is the two-way attenuation effect due to the vegetation layer, σ^o_s is the backscattering contribution of the soil underneath, σ^o_{dv} is the direct backscatter contribution of the vegetation cover, and σ^o_{int} represents multiple scattering due to soil-vegetation canopy interactions.

The last model for σ^o to be reviewed models the σ^o measured over bare soils, taking into account soil moisture and incidence angle [1]:

$$\sigma^o_s = C_1 + C_2\cos(\theta)^{C_3} + dm_\upsilon$$

where C_1, C_2, and C_3 correspond to the backscattering coefficient of dry soil for $\theta = 90^\circ$, the total dynamics of soil response over the $0^\circ \le \theta \le 60^\circ$ range, and a shape factor,

in volumetric soil moisture. Other important details of the formulation are found in the reference article.

Summary

The papers mentioned in this chapter represent a small sample of the available literature related to σ^o measurements. Several efforts are directed towards remote sensing applications that seek to optimize the use of the limited earth resources. Also, military applications arising from the theory and measurements of σ^o logically follows. Target recognition technologies seek to precisely identify targets camouflaged on the ground. Hence, an understanding of ground clutter, as quantified by σ^o, and of the scattering mechanisms is crucial to create effective target acquisition algorithms. In the next chapter, a method of simulating σ^o values based on measured data is introduced. In contrast to some models described in this chapter, the σ^o generator behaves in a statistical manner, yielding histograms similar to those of measured data.

III. Backscattering Coefficient Generator Development

The developmental aspects of the σ^o generator are explained in this chapter. The main idea behind the σ^o generator is to determine a functional form that can simulate the first and second moments of the backscattering process for various terrain types in a statistical way. By "statistical" it is meant that the generator returns a σ^o number that is different every time it produces such a value. Further, the frequency of occurrence histograms of the generated σ^o values must be similar to those of measured σ^o histograms when the generator produces enough samples.

Model Formulation

The following equation is the functional form described in (1) and repeated here for convenience:

$$\sigma = \beta \cdot \left(- \ln(U)^{\alpha} \right) + \gamma \tag{8}$$

The first step in this process is to generate an array (or surface) of values that for possible α–β–γ combinations yields the required mean σ^o and $s(\theta)$ values. Each surface is constructed for a fixed γ value. To illustrate, a typical set of values follows:

$$\alpha = 0.06, 0.061, 0.062, \ldots, 2.0 \tag{8a}$$

$$\beta = 0.01, 0.011, 0.012, 0.013, \ldots, 14.0 \tag{8b}$$

$$\gamma = 0.01 \tag{8c}$$

For each combination of α, β, and γ, an average is calculated upon feeding (4) with an ensemble of $U(0,1)$ randomly generated numbers.

Equivalently, an ordered series is input to (8) having the form

$$\text{Construction Series} = \left\{\frac{1}{N},\frac{2}{N},\ldots,\frac{N-1}{N}\right\} \tag{9}$$

Previous research established that using a readily available uniform $U(0,1)$ generator will not produce a stable $\alpha\text{–}\beta$ set for a given γ [11]. Use of a uniform random number generator at this stage introduced unacceptable variability to the process, making it difficult to determine the optimal $\alpha\text{–}\beta\text{–}\gamma$ set. Equation (9) can be thought of as an ordered collection of random values from a "stable" uniform $U(0,1)$ random number generator. In [11] it was established that a value of N $\approx$ 100,000 produces a stable $\alpha\text{–}\beta\text{–}\gamma$ set. In order to speed up the computational process, N = 1000 was successfully used. This procedural convenience did not affect the desired characteristics of the σ^{o} generator. Testing of the σ^{o} generator used in combination with a uniform random number generator converged to the published mean σ^{o} and s(θ) values when enough samples were produced.

The resulting sequence is converted to decibels by using:

$$\sigma_i^{o}{}_{(dB)} = 20\log_{10}(\sigma_i) \tag{10}$$

The sequence of values in (10) is then averaged to yield the mean σ^{o} value [3]

$$\bar{\sigma}^{o} = \frac{1}{n}\sum_{i=1}^{n}\sigma_{i(dB)} \tag{11}$$

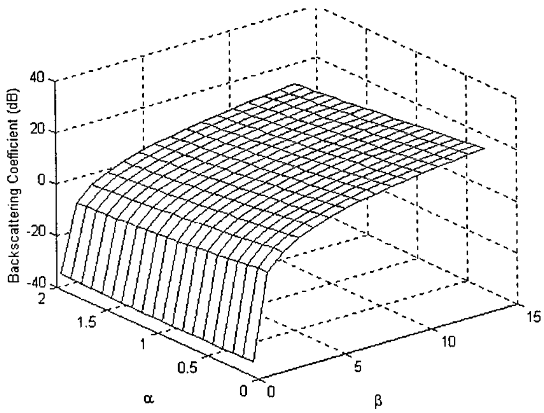

Figure 4. Array of Mean σ^o Values.

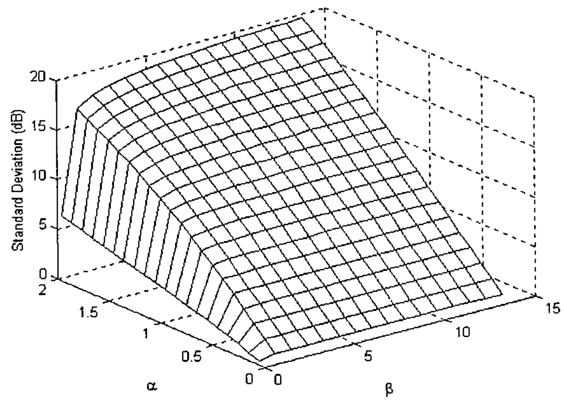

Figure 5. Array of $s(\theta)$ Values.

The standard deviation of the ensemble, $s(\theta)$, is given by:

$$s(\theta) = \left[\frac{\sum_{i=1}^{n} \left(\sigma_{i(dB)} - \bar{\sigma}^o \right)^2}{n-1} \right]^{\frac{1}{2}} \tag{12}$$

Each mean σ^o and $s(\theta)$ value is built into the two-dimensional arrays according to their α–β values (Figures 4 and 5). The abscissa and ordinate correspond to β and α, respectively. For example, suppose a set of α–β–γ values is specified: α_1–β_1–γ_1 (keep in mind that each surface is built for a fixed γ value). Each resulting mean σ^o and $s(\theta)$ values have *α_1–β_1 coordinates* within their respective arrays. These surfaces constitute "search grids" or surfaces where an exhaustive search seeks to determine an α–β pair that yields the published mean σ^o and $s(\theta)$ values with minimum error.

An adequate measure of the error for this process is given by [11]

$$error = \frac{\mathrm{A} - \mathrm{B}}{\mathrm{B}} \tag{13}$$

The value A represents a proposed value for a variable (i.e., A = σ^o or A = $s(\theta)$) while B is the desired (or measured) value. A measure of error is obtained for both, mean σ^o and $s(\theta)$ surfaces, by subtracting and normalizing these by the mean σ^o or $s(\theta)$ value of interest:

$$error = ABS\left(\frac{\begin{bmatrix} 1 & \rightarrow & N \\ \downarrow & & \downarrow \\ M & \rightarrow & MN \end{bmatrix} - B}{B} \right) \tag{14}$$

where the array of dimension *MN* can be either the σ^o or $s(\theta)$ array (surface). *B* is the desired σ^o or $s(\theta)$ value, while *ABS* stands for absolute value.

The total error (TE) is given by

$$TE = \sigma^o\, error + s(\theta)\, error \tag{15}$$

where σ^o *error* and $s(\theta)$ *error* are calculated using Equation (14). The *TE* array is a surface of the error incurred given the calculated and desired mean σ^o and $s(\theta)$ values (Figure 6). The search algorithm finds the minimum combined error and determines which α–β pair produced this minimum value. Notice the minimum error combination at $\beta \approx 1$ and $\alpha \approx 0.5$ (Figure 6). The algorithm further refines the estimate until the desired level of decimal accuracy is reached. The algorithm will also stop after it exceeds a preset threshold and a satisfactory α–β pair has not been found.

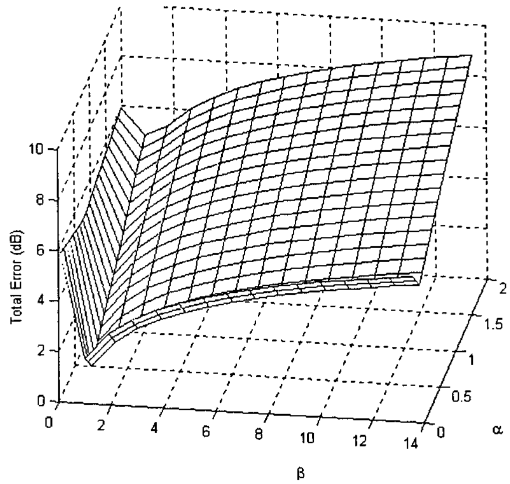

Figure 6. Total Error Array

The criterion used to select the range of α–β–γ values is based on experimental experience. In this research, it was found that by extending the α sequence to include values smaller than 0.16 (i.e., 0.06) convergence was possible for all distributions.

In [11], it was found that a search grid that is dense for small values of α–β and sparse for large values of these variables provides an adequate search surface. Alternatively, a "partial surface" approach was tested. In this method, only those areas in the surfaces that contained the mean σ^{o} and s(θ) values of interest were kept. However, this method failed to converge to α–β–γ sets that produced minimum error combinations for the values of interest. The variable density search method was used instead with the expected results. The use of variable density search spaces results in computational timesaving.

Properties of σ^{o} Generating Function

Equation (8) has a discrete output dependent on the α–β–γ combinations and the ensemble of $U(0,1)$ random values. A histogram of the output indicates that the resulting distributions can be regarded as Weibull (Figure 7). A percentile plot suggests this to be true (Figure 8), which is representative of most generated distributions [3]. The α–β–γ values determine the shape of the function's histogram. The value of γ can be increased or decreased to adjust the shape of the generated histogram and conform it to the

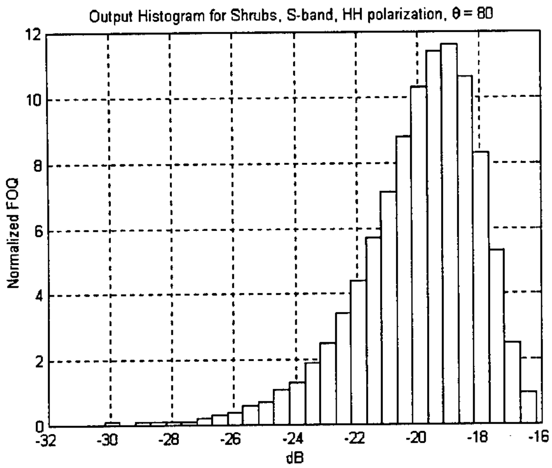

Figure 7. σ^0 Generator Output Histogram.

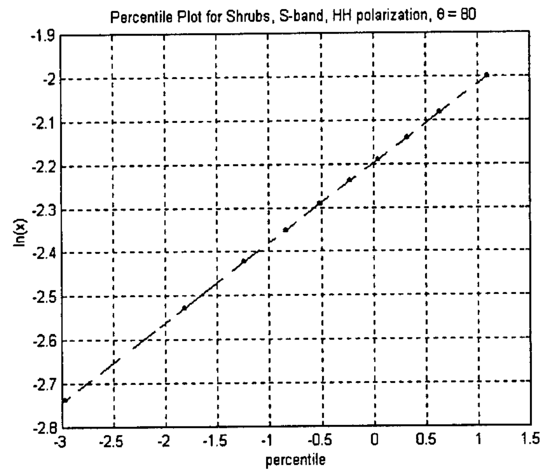

Figure 8. Percentile Plot of σ^0 Generator Output in Figure 7.

measured data histogram. Adjustments to γ have little effect when the generated histogram's shape departs significantly from the measured data histogram. The bin width of the histograms is 0.5 dB.

Data Quality and Pre-Processing

The data used in this research represents a calibrated compilation of σ^0 measurements from several studies [8:79]. It is the most comprehensive to date, although data quantity varies by terrain type and measurement conditions.

The data sets were qualified by evaluating whether the mean σ^0 and s(θ) data points could be interpolated to yield "reasonably" shaped curves (such as seen in Figure 3). A *data set* is any table entry such as "I-5, X Band, HH Polarization" from the reference database [8:91]. The number of source data points (N) supporting each mean σ^0 value and the shape of the interpolated curves were also considered. This data pre-processing was necessary due to the high variability in N within and across data sets (Figure 9) [8].

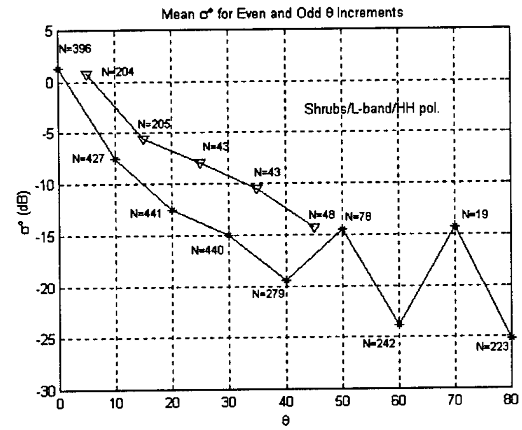

Figure 9. Partition of Data Points by Even and Odd Incidence Angles.

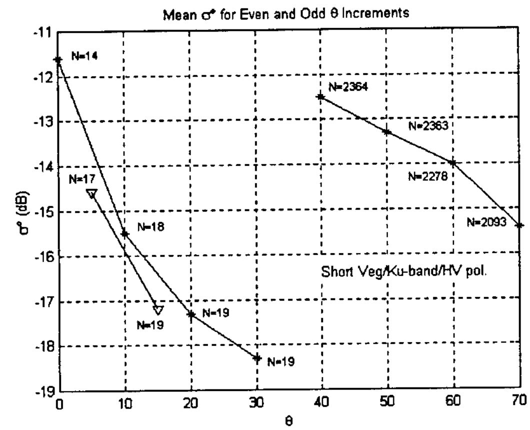

Figure 10. Partition of Data Points as in Previous Figure.

The mean σ^o curve's shape is strongly linked to N (Figures 9, 10, and 11). Note that the s(θ) curves also reflect the same anomalies as the σ^o curves (Figure 12).

Figure 10 shows cases where the σ^o data sets have markedly different N for the first six data points, yielding a highly irregular mean σ^o curve. This curve was corrected by discarding the five degree increments and raising the remaining σ^o data points by an amount such that the resulting curve had the characteristic mean σ^o contour. A similar process was applied to other mean σ^o curves exhibiting the same behavior.

A case where no data point was discarded is illustrated in Figure 11. Inclusion of the data point $\theta = 30^o$ did not cause significant degradation of the interpolated mean σ^o curve.

Another pre-processing example is provided by Figure 12. At first glance, the data points at $\theta = 50^o$ and 55^o seem to be outliers. However, these mean σ^o values were generated with a higher N than the rest of the points. One could rightly argue that the higher the number of sample data points, the closer the measurement would be to its real

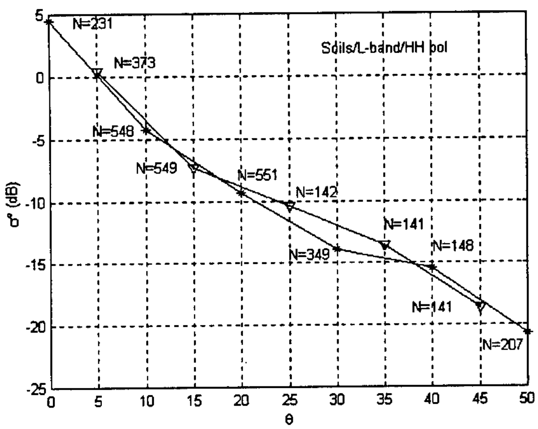

Figure 11. σ^o Curve for Soils

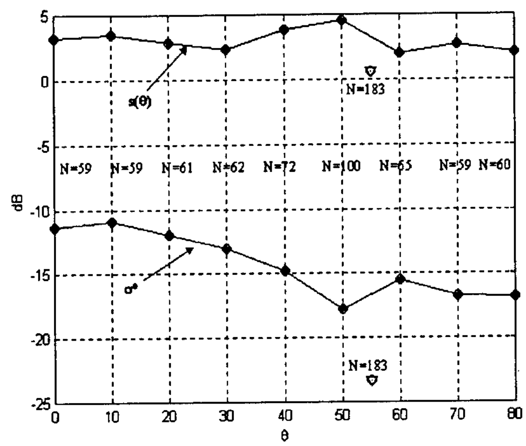

Figure 12. σ^o and s(θ) Curves for Trees, X-Band, HV Polarization

value. However, it was decided to discard these data points in favor of the remaining others. Keeping the majority of the data points provided us with more instances to test the σ^o generator's simulation capabilities. Moreover, this assures that the σ^o generator output follows closely the accepted theory.

Simulation of the data collected over urban areas presented a special situation. Analysis of the data indicated badly behaved mean σ^o curves. This is no surprise since the database authors warn readers that the mean σ^o curves of urban areas may not portray accurately the true backscattering response of this terrain type. It is reasonable to infer that these urban areas may contain strong corner reflectors (buildings, wall layouts, etc.) which may influence measurements at certain radar frequencies and incidence angles. Incidentally, this terrain type has the one of the lowest number of supporting studies in the database, i.e., lowest N. This terrain type is included in this research for experimental purposes [8:87].

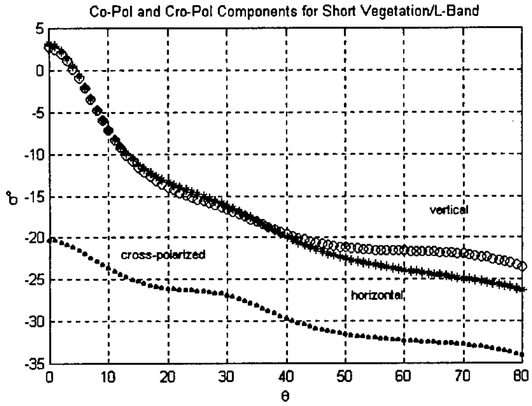

Figure 13. Spline Interpolation of σ^o Data Points for Short Vegetation.

In general, the ten-degree increments were the best documented in the database, as well as the group to approximate closely the theoretical curve behavior. Hence, these were the σ^o data source points most often used.

Interpolation of the mean σ^o and $s(\theta)$ curves was necessary to achieve the required 1^o angular resolution. The primary reference applies an iterative least squares and non-linear curve-fitting routine to interpolate these curves for all incidence angles [8]. However, it is desired to accurately reproduce the mean σ^o and $s(\theta)$ measurements at each angle where data is available. Hence, an alternative method of interpolation by cubic splines was used. A spline curve fitting routine connects every known data point with a smooth curve that yields a good approximation to the theoretical σ^o curves shown in Figure 3. For these purposes, MATLAB®'s *spline* routine was used. In Figure 13 a "best case" interpolation example is shown for short vegetation at L-band, which closely resemble the curves in Figure 3.

A similar problem as the one described above for σ^o data points from angle to angle within a data set occurs across data sets. In other words, for the same terrain type, radar band, and incidence angle, N generally differs for HH, HV, and VV polarizations. Such an instance is illustrated by shrubs at $\theta = 5^o$ (L band), N = 204, 74, and 160 for horizontal, cross, and vertical polarizations, respectively [8:200]. This peculiarity reflects on the σ^o measurement history rather than on the database's completeness. This may explain why the resulting shape of the interpolated curves can be irregular.

After applying the analysis outlined above, 129 data sets out of 155 were deemed qualified for interpolation and subsequent processing.

Validation of Results

A multinomial test of proportions was implemented to test how well the generated histograms (output of Equation 8) matched the measured (*observed*) data histograms. This is a chi-square goodness-of-fit test variation where two distributions having a different total number of counts are compared. For instance, the output of the generator was generally about 100,000 counts. The observed counts (same as N) varied from the low tens to approximately 5,000 observations per histogram. To assess distribution likelihood between generated and observed count histograms, the predicted counts histogram is normalized. Then, each of its bins is multiplied by the total number of observed counts. Consequently, the sum of all generated (or *predicted*) counts equals the total number of observed counts. Predicted and observed counts are grouped in histograms having k bins or cells. Each bin has width of 0.5 dB, consistent with the database's convention [8].

Next, a null hypothesis and an alternative hypothesis are proposed. The null hypothesis is that the predicted counts histogram is a good fit to the observed counts histogram. The alternative hypothesis logically follows [3:586].

The following test statistic is used to test the null hypothesis:

$$\chi^2 = \sum_{all\ cells} \frac{(observed - predicted)^2}{predicted} \tag{16}$$

The test statistic value is compared to the chi-square value obtained from tables or from a computerized algorithm. The null hypothesis is rejected when the test statistic is larger than the chi-square value.

The chi-square value depends on two factors: the level of significance and the number of degrees of freedom. The level of significance can be regarded as the tolerance of the test. A level of significance of 0.05 is used in this research, which is considered a high level. In other words, if the null hypothesis can not be rejected, we can be 95% confident that this result was not due to chance. The number of degrees of freedom is defined as k-1 where k is the number of bins per histogram [3:586].

In a chi-square test, each bin must have a minimum number of counts. In this research a minimum number of one is used [5:711]. Due to the normalization of the generated data, the number of predicted counts in any one bin may be less than one. Adjacent bins are combined together to achieve the minimum number of counts. The observed count bins are collapsed accordingly.

IV. Experimental Results

This section discusses the results and issues encountered in the σ^o generator development. The main focus in this investigation is to develop the σ^o generator for all types of terrain and measurement conditions published in the database [8].

Experimental Data Validation

Short Vegetation, Ku-Band, HV, $\theta = 50°$, N=1715

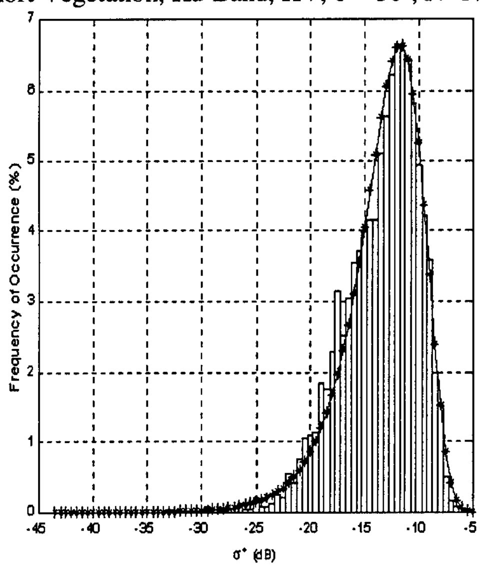

Figure 14. TS = 74. NTS = 3.2. $\chi^2 = 64$

Several issues ensued in the validation phase. Perhaps, the most significant problem was the mixture of well and poorly documented incidence angles within a data set. Although a data set may have been qualified after pre-processing, this does not imply that all of its data points were supported by a high N (see Chapter III, Data Quality and [8:210,215]). Validation results were affected by the value of N. As N increased (hundreds to thousands), any small deviation between the predicted and observed counts histograms resulted in rejection of valid null hypotheses. This is shown in Figure 14, where TS is the test statistic, NTS is the normalized test statistic (to be discussed shortly), and $\chi^2_{\alpha,\, k\text{-}1}$ is the chi-square value.

On the other hand, when the measured counts were low ($N \leq 100$) the test did not reject ambiguous or invalid null hypotheses in almost all instances (Figure 15). Visual

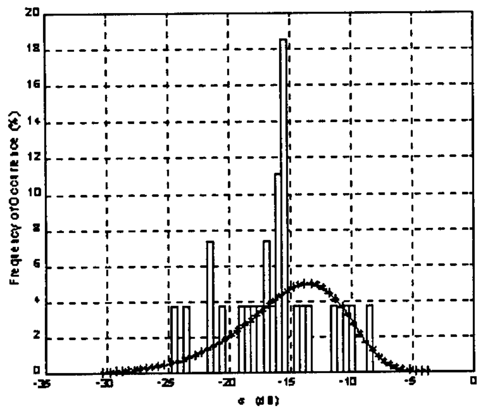

Figure 15. Grass/S-Band/HV pol./$\theta = 5^o$,
N = 27, TS = 25. NTS = 92. $\chi^2 = 31$.

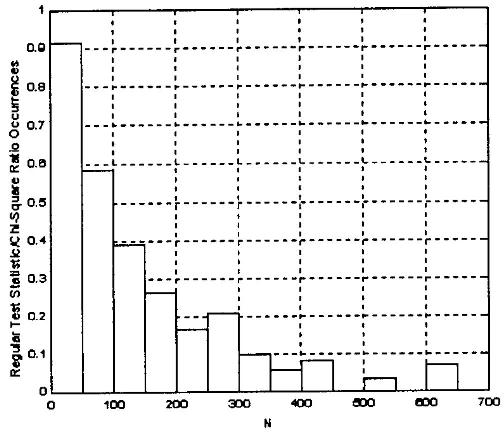

Figure 16. Chi-square Test Success Rate Distribution

inspection of the histograms indicated that a reasonable conclusion could not be reached due to the low number of observed samples and sparse histograms.

The chi-square test seemed to be prone to reject the null hypothesis when N was high and viceversa. To test this suspicion, a ratio test was devised:

$$\text{ratio test} = \frac{\chi^2}{\chi^2_{\alpha,k-1}} \tag{17}$$

where the numerator is the test statistic in Equation (16) and the denominator is the chi square value for a significance level α and k-1 degrees of freedom. When the null hypothesis is not rejected, the numerator will be smaller than the denominator yielding a ratio less than one. The opposite occurs when the null hypothesis is rejected. The histogram in Figure 16 shows what fraction of chi-square tests within each bin yielded a ratio test less than one. It is seen that the validation test tends not to reject the null hypothesis when N ranges in the low tens and hundreds. The test behavior was incompatible with the goal of validation process automation. An alternative approach, a

modified chi-square test, was tested and implemented. This test yielded good results for a greater range of N values as confirmed by a detailed review of all validation test results.

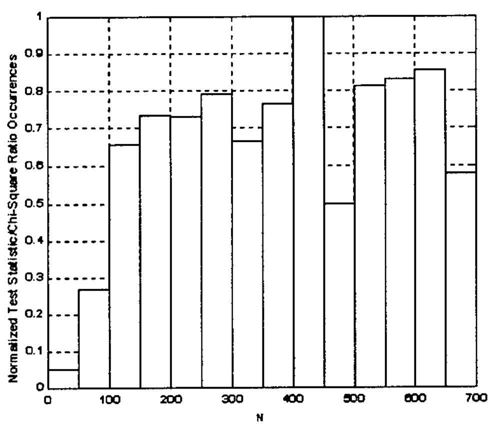

Figure 17. Normalized Chi-square Non-rejection Rate.

The test is implemented as an ordinary chi-square test except that both, *predicted* and *observed* bin counts, are normalized to one hundred. Due to this normalization, the test statistic in Equation 16 is called the normalized test statistic (NTS). This test performed better than the regular chi-square test, especially for low N. Figure 17 shows the ratio test results for the normalized chi-square test (Equation 17). It is seen that the test's success rate is better distributed along the range of samples shown.

However, the modified chi-square test did not reject inconsistent null hypothesis for certain high N situations where the measured data histograms had a wide distribution (Figure 18). These were data sets that the functional form (Equation 8) could not accurately represent, most frequently for low incidence angles in the region $\theta < 20^{o}$. Fortunately, failure of the test was extremely rare (less than 5 occasions in 958).

On the other hand, the modified chi-square test did fail generated distributions that, to the naked eye, appeared acceptable (Figure 18(b)). This is noticeable especially for distributions with $100 \leq N \leq 200$, approximately. Of course, the test is designed to take into account bin height differences between generated and measured histograms the naked eye cannot detect. A list of these distributions is included in the appendix.

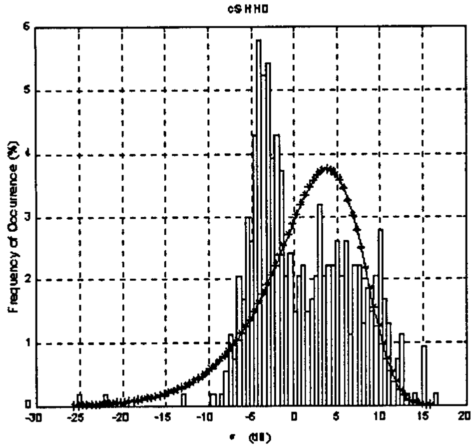

Figure 18(a). Validation Results for Short Vegetation: TS = 87, NTS = 63, χ^2 = 65, N=535

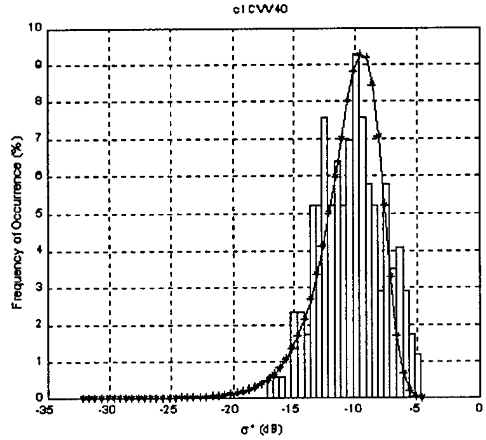

Figure 18(b). Validation Results for Grasses: TS = 115, NTS = 67, χ^2 = 34, N = 172

The observations outlined above serve as an introduction to a more detailed treatment of the results by terrain type. Figures 19 - 27 show graphical output of the generator (dark line) on top of measured data histograms (rectangular bins). The title of each figure describes the terrain type, radar band, polarization, and angle of incidence. For example, aLHH0 means soils and rocks, L band, HH polarization, and $\theta = 0^o$. The test statistic, chi-square value, and normalized test statistic values are in the appendix.

Soils and Rocks

In general, this terrain type (type "a") is well documented with N's ranging in the thousands for some cases [8:130]. The main discrepancies between the σ^o generator and the measured data were found mostly at low incidence angles ($0^o \leq \theta \leq 30^o$). Excellent agreement was observed for L, S, and Ku band for $N \geq 100$. C band performance was acceptable (close to 70% success rate) while X band performance was poor (Figures 19(a-i)).

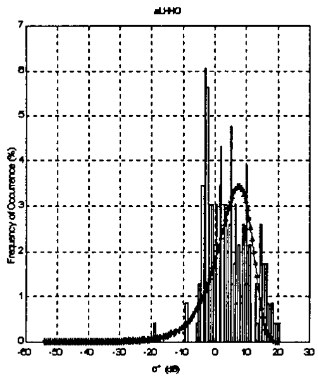

Figure 19 (a) aLHH0

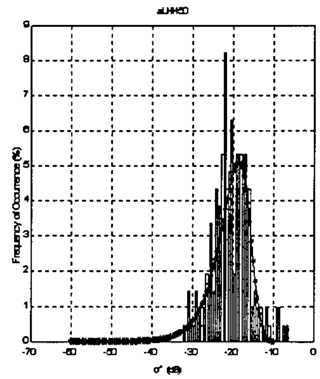

Figure 19 (b) aLHH50

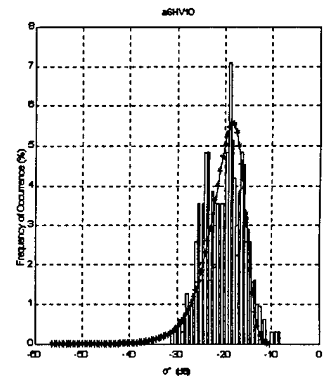

Figure 19 (c) aSHV10

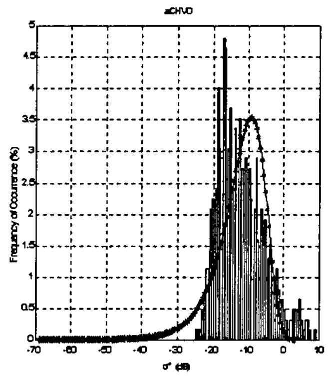

Figure 19 (d) aCHV0

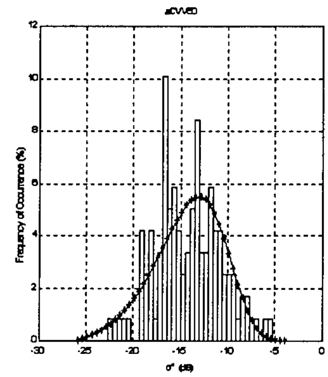

Figure 19 (e) aCVV50

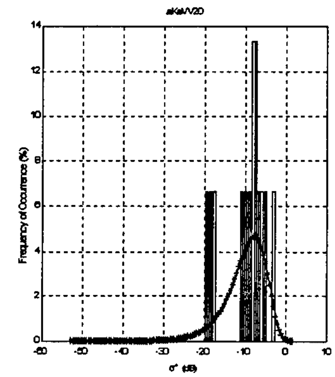

Figure 19 (f) aKaVV20

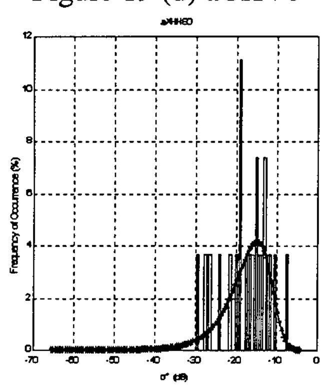

Figure 19 (g) aXHH80

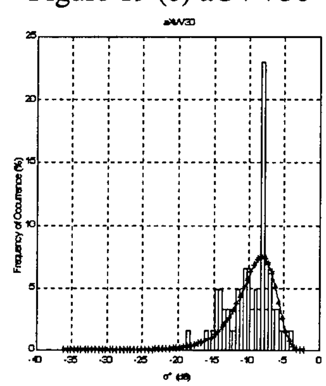

Figure 19 (h) aXVV30

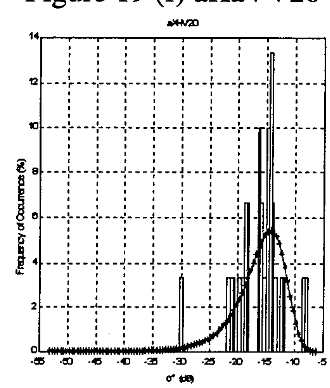

Figure 19 (i) aXHV20

<u>Trees</u>

This category (type "b") was difficult to assess and preliminary validation tests produced high rejection rates. Visual analysis of the data showed three typical situations: 1) distribution rejection for low incidence angles, 2) rejection due to low number of distribution samples of fair distributions, and 3) rejection of fair distributions. About 97% of all distributions have $N \leq 100$. The generator performance was poor for this

terrain type (Figures 20(a-i)). Special distribution instances, such as bimodal distributions, were noted in this terrain type. Figure 20 (h) illustrates a bimodal distribution with N = 70. It is reasonable to suspect that this situation is due to low N.

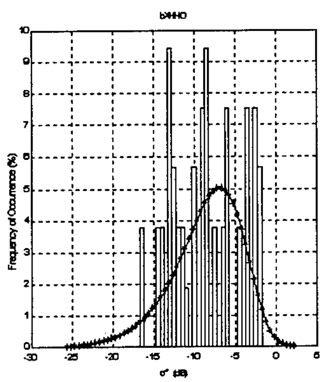

Figure 20 (a) bXHH0

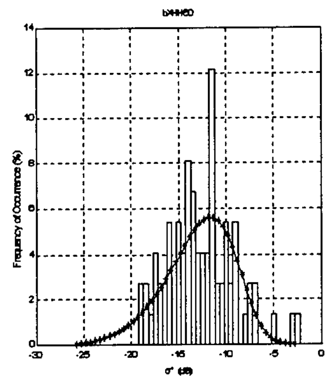

Figure 20 (b) bXHH60

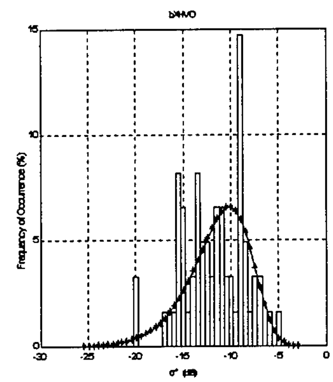

Figure 20 (c) bXHV0

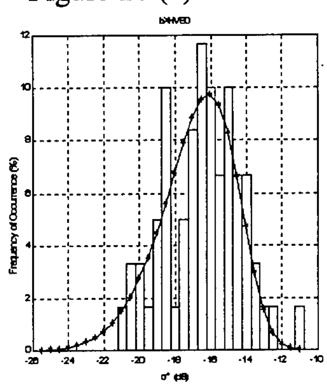

Figure 20 (d) bXHV80

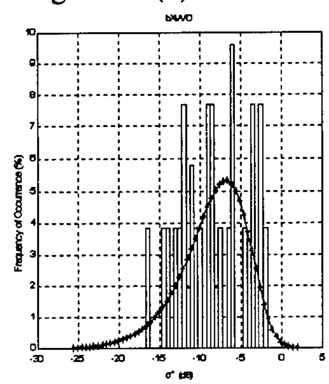

Fig 20 (e) bXVV0

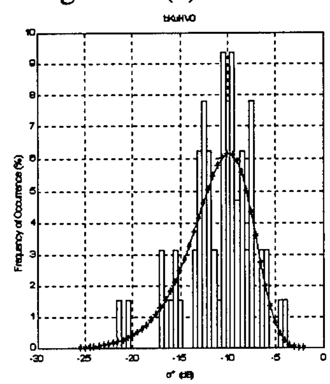

Figure 20 (f) bKuHV0

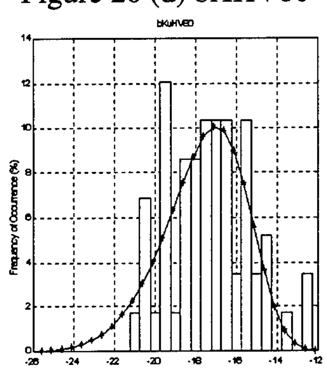

Figure 20 (g) bKuHV60

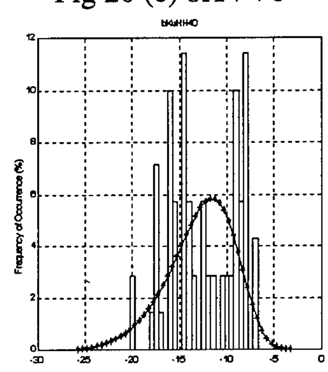

Figure 20 (h) bKuHH40

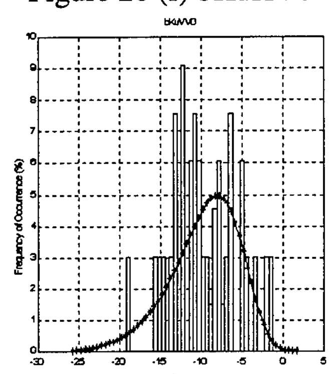

Figure 20 (i) bKuVV0

Grasses

This terrain type (type "c1") featured high N for many data sets. The generator performed well for all radar bands except L band (Figure 21 (a-i)).

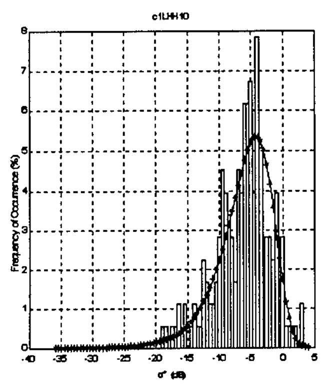

Figure 21 (a) c1LHH10

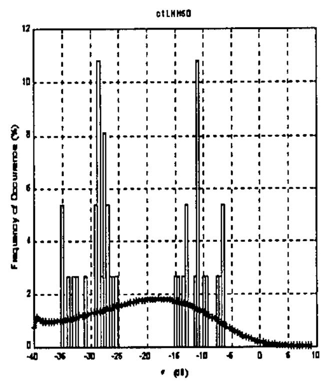

Figure 21 (b) c1LHH50

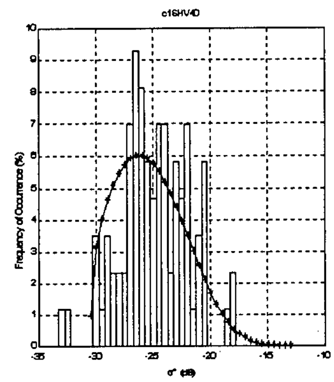

Figure 21 (c) c1SHV40

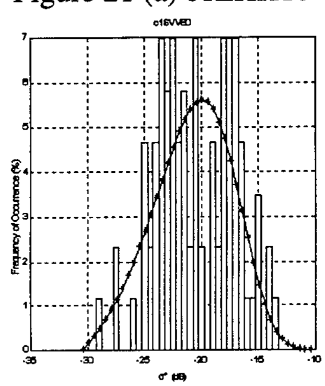

Figure 21 (d) c1SVV60

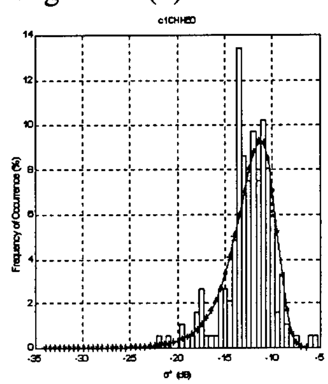

Figure 21 (e) c1CHH60

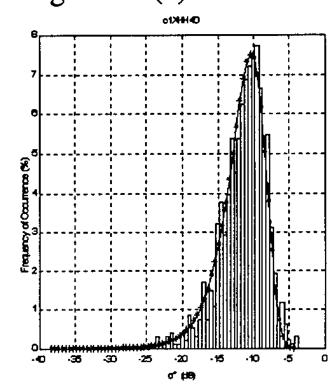

Figure 21 (f) c1XHH40

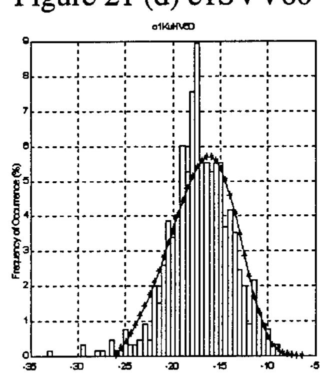

Figure 21 (g) c1KuHV50

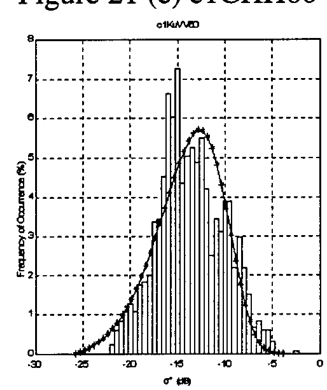

Figure 21 (h) c1KuVV60

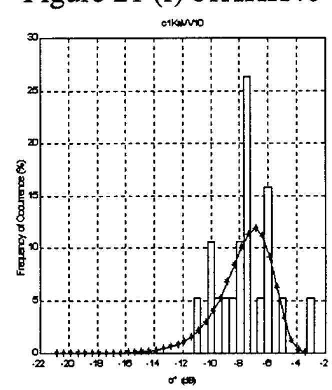

Figure 21 (i) c1KaVV10

Shrubs

The σ^o generator performed satisfactorily for this terrain type (type "c3") for most incidence angles (Figures 22 (a-i)). Discrepancies were noted in the region $0^o \leq \theta \leq 30^o$ for all data sets, especially when $100 \leq N \leq 200$. The generator had excellent to acceptable performance for all bands. The average success rate was 65%.

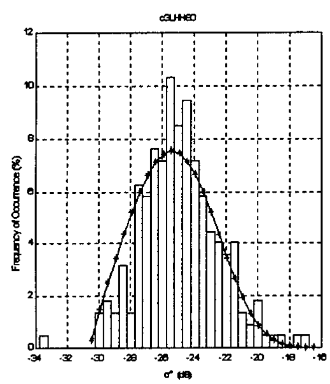

Figure 22 (a) c3LHH80

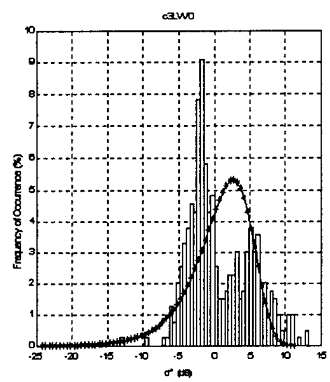

Figure 22 (b) c3LVV0

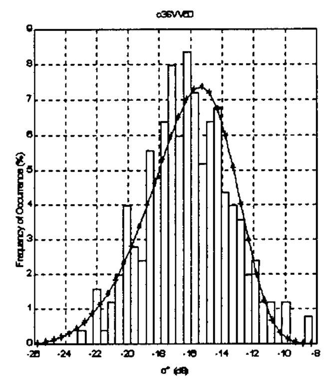

Figure 22 (c) c3SVV60

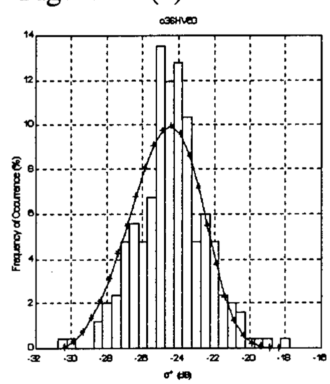

Figure 22 (d) c3SHV60

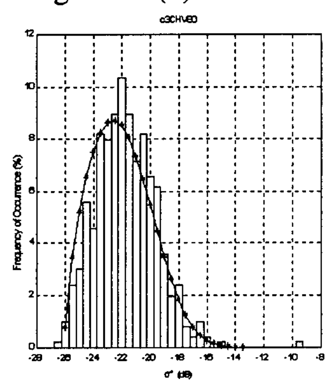

Figure 22 (e) c3CHV60

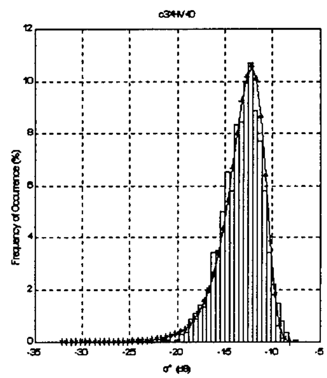

Figure 22 (f) c3XHV40

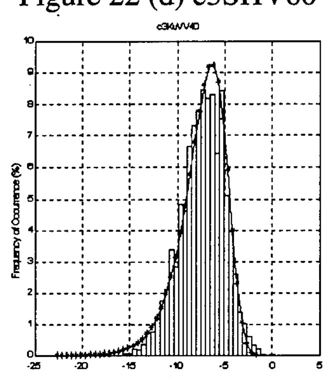

Figure 22 (g) c3KuVV40

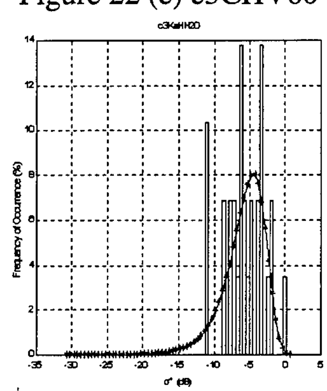

Figure 22 (h) c3KaHH20

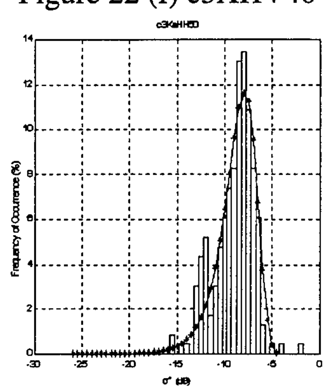

Figure 22 (i) c3KaHH50

Short Vegetation

This terrain type (type "c") featured good agreement for most well documented data sets (N > 100) for $\theta \approx 30^{\circ}$ and above (Figures 23 (a-g)). Average success rate was about 80%. Excellent to good performance for all radar bands. Incidentally, this terrain type features very large N [8:247].

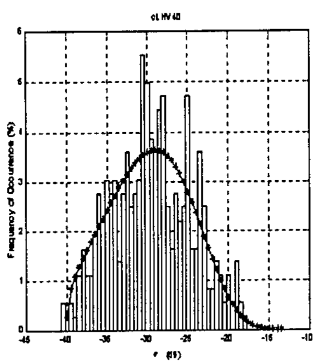

Figure 23 (a) cLHV40

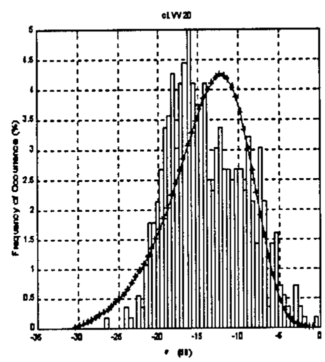

Figure 23(b) cLVV20

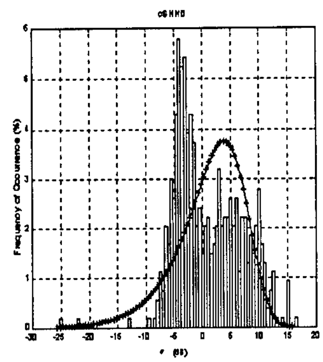

Figure 23(c) cSHH0

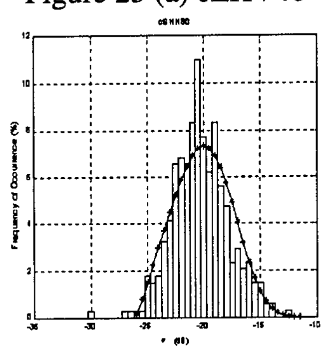

Figure 23 (d) cSHH80

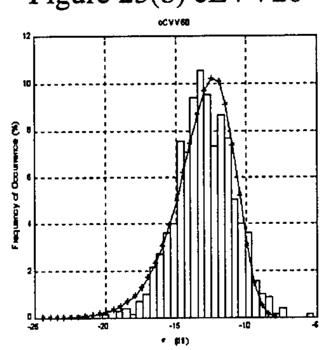

Figure 23 (e) cCVV60

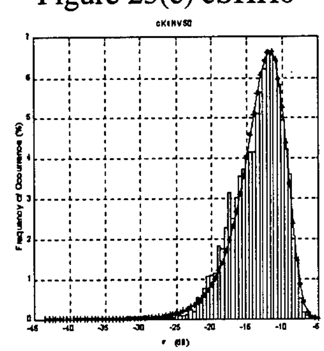

Figure 23 (f) cKaHV50

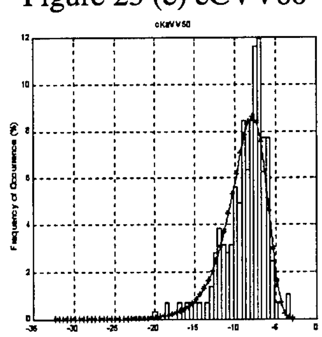

Figure 23 (g) cKaVV50

Roads

This terrain type (type "d") was characterized by N < 100 and sparse histograms. Some of the distributions were well suited for description using uniform distributions (Figures 24 (a-c)). Consequently, the generator performance was poor. However, a fair assessment of the modeling capabilities of the σ^0 generator for this terrain type requires a higher N.

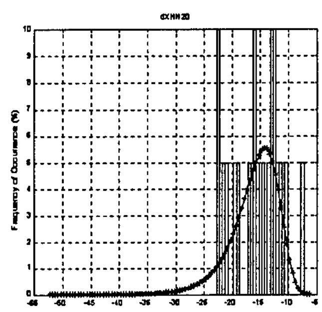

Figure 24 (a) dXHH20

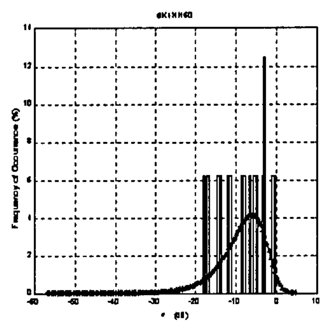

Figure 24 (b) dKuHH60

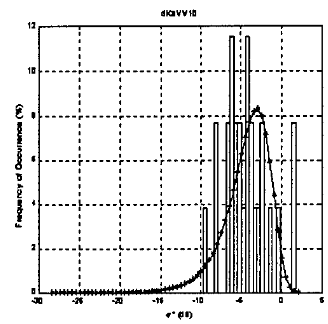

Figure 25 (c) dKaVV10

Dry Snow

For this terrain type (type "f"), the σ^0 generator performance varied from excellent to good for distributions with $N \geq 100$ and L, S, C, and Ku radar bands (Figures 25 (a-i)). The success rate was about 70% for these bands. Also, visual inspection of rejected histograms demonstrated good agreement between the σ^0 generator and measured data (appendix).

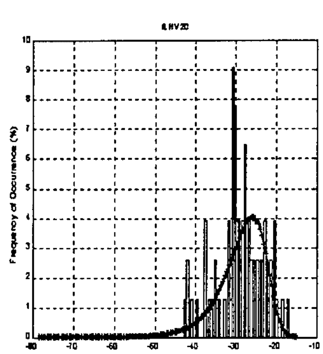

Figure 25 (a) fLHV20

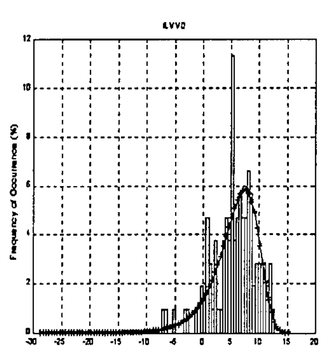

Figure 25 (b) fLVV0

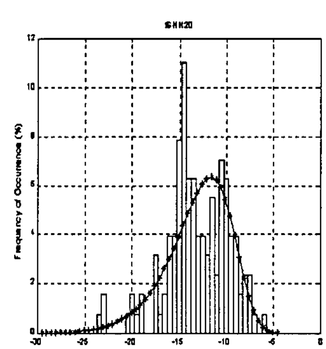

Figure 25 (c) fSHH20

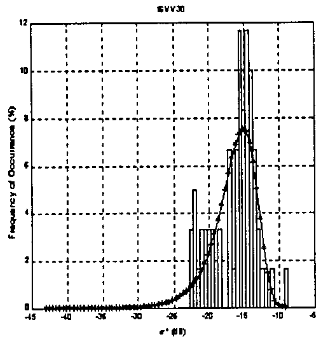

Figure 25 (d) fSVV30

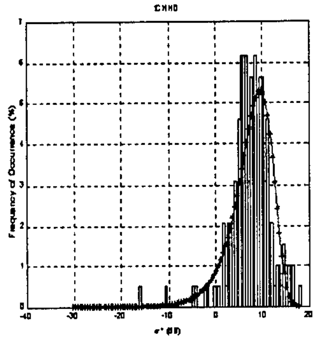

Figure 25 (e) fCHH0

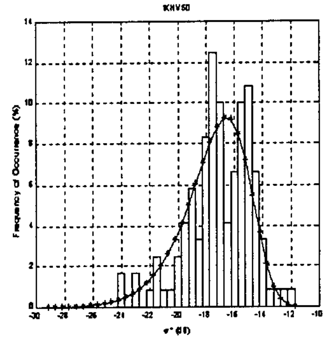

Figure 25 (f) fXHV50

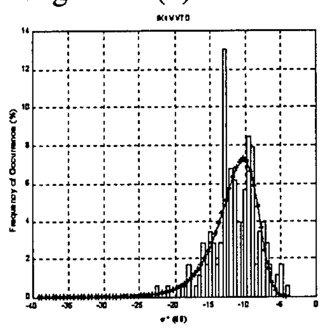

Figure 25 (g) fKuVV70

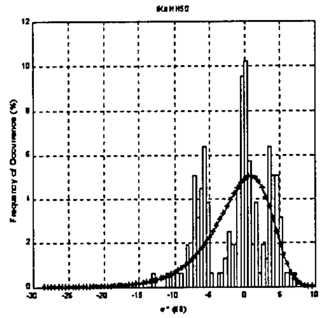

Figure 25 (h) fKaHH50

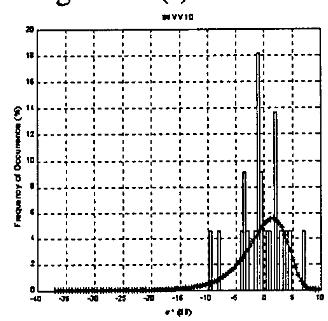

Figure 25 (i) fWVV10

Wet Snow

For wet snow (type "g"), the σ^0 generator functional form yielded good agreement for C, X, Ku, and Ka bands with a success rate of about 75% (Figures 26 (a-i)). Performance was poor for L and S bands at low incidence angles.

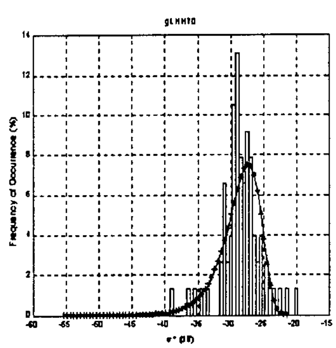

Figure 26 (a) gLHH70

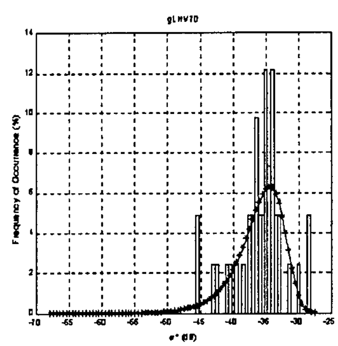

Figure 26 (b) gLHV70

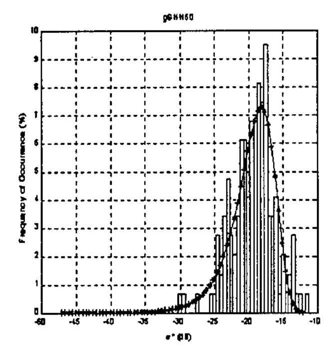

Figure 26 (c) gSHH80

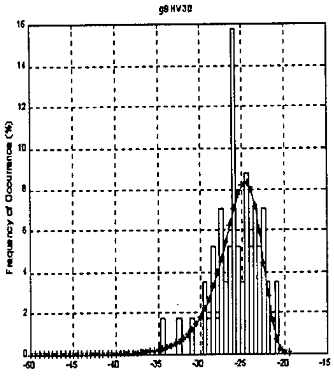

Figure 26 (d) gSHV30

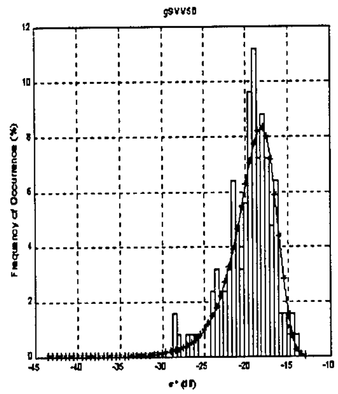

Figure 26 (e) gSVV50

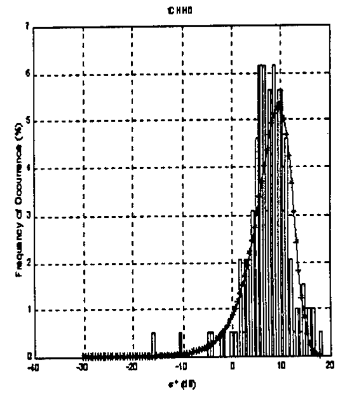

Figure 26 (f) fCHH0

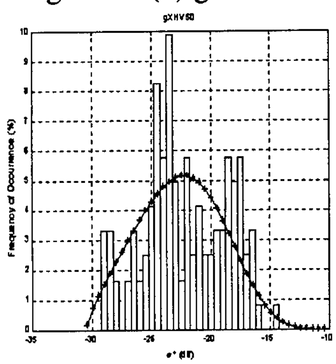

Figure 26 (g) gXHV50

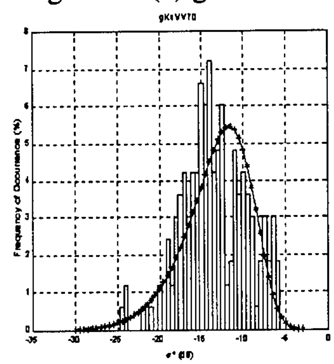

Figure 26 (h) gKuVV70

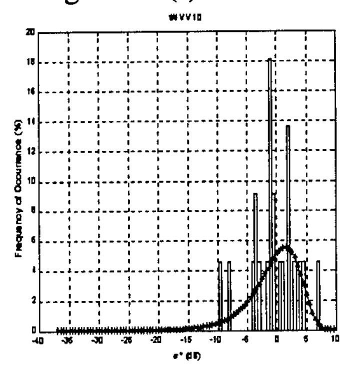

Figure 26 (i) fWVV10

Summary of Results

The experimental results demonstrate the soundness of the σ^0 generator approach. The function in (8) has broad applicability to several terrain types, wave polarization, and incidence angle accounting for an overall success rate of 72% for distributions with source data points (N) greater than or equal to 100. These observations are documented in the appendix.

In general, the σ^0 generator performed well for short vegetation, shrubs, and soils and rocks except in the sector $0^\circ \leq \theta \leq 20^\circ$. The distributions at these incidence angles exhibited strong Rayleigh behavior. For wet snow and dry snow, good agreement could be observed for all incidence angles. Roads and trees have the lowest N of all types; hence, rejection rates were high.

It is difficult to explain why the success rate is not higher based on the limited amount of data and its distribution across terrain types. For instance, the σ^0 generator performed very well for short vegetation and shrubs except for low incidence angles. Incidentally, these terrain types have the highest total N. The opposite occurs for terrain types such as trees and roads (appendix). It would be speculative to assert that as N is increased for all terrain types, the σ^0 generator will perform at least as good as for shrubs and short vegetation. However, it is a possibility given the experimental results.

The modified chi-square test proved to be a proper metric. However, when the normalized test statistic and the chi-square value are commensurate, it is advisable to visually judge the generated and measured histogram likelihood. This is also true when N ≤ 200, approximately, and when observed data histograms have wide distributions.

V. Conclusions and Recommendations

The functional form in (8) accurately converged to the published mean σ^o and $s(\theta)$ values for nine terrain types, radar bands, the linear pair of wave polarizations, and incidence angles lower than 80^o. Equation (8) was also shown to exhibit the same frequency of occurrence histograms for approximately 72% of measured σ^o distributions with database-source-points (N) $\geq$ 100. Above average results were noted for short vegetation (78%), soils and rocks (75%), and grasses (74%). However, experimental results suggest that an alternate functional form (or modification to the current form) may be necessary to accurately portray short vegetation, soils and rocks, grasses, and shrubs for low incidence angles. This inconsistency was not observed for dry and wet snow where the σ^o generator performed well for all incidence angles (72% and 69% success rates, respectively). Roads and trees require a higher N in order to establish the σ^o generator suitability. Terrain type "urban" was not validated since all of its distributions exhibited low N.

A consequence of the variability in N is that within σ^o data sets that had a high number of failed distribution tests, a success could be found. The converse was also true. This variation affected the reliability of the validation tests. Certainly, data quantity and quality is an important factor to be considered for future work.

The following recommendations are given:

(1) Campaigns to measure σ^o for several terrain types to avoid the variability in N found within data sets for all incidence angles. This will help to precisely evaluate the σ^o generator in a "controlled" setting.

(2) Explore alternative functional forms that resemble the behavior of σ^o curves. Available statistical software packages can be used for this purpose.

(3) A modification to the functional form to appropriately model the σ^o from certain terrain types for low incidence angles.

(4) Further refinement of the normalized chi-square test to signal when the computational process achieves the desired σ^o, $s(\theta)$ values, and frequency of occurrence histogram simultaneously.

Appendix: Simulated Data Sets

This appendix contains the generated data for this research. A summary for all generated and validated distributions is included in page 44. The data set groups included are *udmod0, udmod1*, *udmod2*, *udmod3*, and *udmod4a*.

The name of the data set group denotes the data set composition. For example, *udmod0* includes all published data sets whose mean σ^o values were supported by $N \geq 16$. Hence, zero distributions had $N < 16$. The data set group *udmod4a* is composed of data sets that have four or more incidence angles with $N < 16$.

Each data set table in the appendix has 14 labeled columns:

(1) IA = incidence angle

(2) Mean = published mean σ^o value

(3) ResMean = generated mean σ^o value

(4) StD = published $s(\theta)$

(5) ResStD = generated $s(\theta)$

(6) Alpha = alpha parameter

(7) Beta = beta parameter

(8) Gamma = gama parameter

(9) TstStat = test statistic

(10) OAChi = chi-square value

(11) NormTS = normalized test statistic

(12) N = source data points

(13) NTS/OACHI = ratio test for NormTS

(14) TS/OACHI = ratio test for TstStat

A value of -1 in column (10) indicates that the number of histogram bins in a distribution was less than two. Validation tests were not done on distributions with less than two bins.

The following line in the table describes the terrain type and measurement conditions. For instance, ACHH0 denotes terrain type A (also referred as *a*), C-Band, HH polarization, and γ value. The terrain type code in italics is also used in this research, specifically when validating the generated distributions. The following list describes all terrain types, radar bands, and polarizations [8:88]:

(1) A, *a* = soils and rocks

(2) B, *b* = trees

(3) C, *c1* = grasses

(4) D, *c3* = shrubs

(5) E, *c* = short vegetation

(6) F, *d* = roads

(7) G, *e* = urban

(8) H, *f* = dry snow

(9) I, *g* = wet snow

(10) L = 1-2 GHz

(11) S = 2-4 GHz

(12) C = 4-8 GHz

(13) X = 8-12 GHz

(14) Ku = 12-18 GHz

(15) Ka = 30-40 GHz

(16) W = 90-100 GHz

(17) HH, VV = co-polarized components

(18) HV = cross-polarized components

The summary table gives a bird's eye view of validation results by terrain type and radar band. Validation tests are for normalized and regular chi square tests for two range of samples: 1) $N \geq 16$ and 2) $N \geq 100$. The label GE and LE mean *equal or greater than* and *equal or less than*, respectively.

TYPE	DATA SETS	DISTRIBUTIONS	N GE 16	NTS LE 1	TS LE 1
AL	3	29	29	23	6
AS	3	21	21	15	4
AC	3	28	28	19	2
AX	3	26	23	2	16
AKU	3	20	19	5	14
AKA	2	14	0	0	0
BL	2	9	2	0	2
BC	3	15	1	0	0
BX	3	26	26	6	12
BKU	3	27	27	5	17
BKA	1	6	0	0	0
CL	3	25	25	7	8
CS	3	27	27	16	15
CC	3	21	21	20	4
CX	3	25	25	18	4
CKU	3	22	22	18	0
CKA	2	16	14	3	13
CW	1	5	0	0	5
DL	3	21	21	17	2
DS	3	21	21	13	3
DC	3	24	24	15	1
DX	3	24	24	13	0
DKU	3	22	22	15	0
DKA	2	13	12	2	10
EL	3	21	21	18	1
ES	3	23	23	18	2
EC	2	23	23	18	0
EX	2	18	18	12	0
EKU	3	22	22	16	0
EKA	2	17	16	4	10
FX	3	27	14	0	13
FKU	3	27	14	1	14
FKA	3	25	14	0	11
HL	3	18	18	7	13
HS	3	18	18	7	10
HC	3	18	18	14	7
HX	3	23	19	6	13
HKU	3	23	19	10	6
HKA	3	24	15	0	4
HW	3	16	9	0	8
IL	3	18	18	4	12
IS	3	18	18	9	12
IC	3	18	18	11	7
IX	3	24	21	6	13
IKU	3	18	18	9	2
IKA	3	16	10	0	6
IW	2	16	3	0	3
TOTALS	129	958	821	402	305
TYPE	DATA SETS	DISTRIBUTIONS	N GE 16	NTS LT 1	TS LT 1

N GE 100	NTS LE 1	TS LE 1
28	23	6
16	13	0
28	19	2
3	0	1
5	5	1
0	0	0
2	0	2
1	0	0
0	0	0
0	0	0
0	0	0
16	3	2
12	11	5
21	20	4
24	18	4
22	18	0
0	0	0
0	0	0
21	17	2
21	13	3
24	15	1
24	13	0
22	15	0
2	2	0
21	18	1
22	18	2
23	18	0
18	12	0
22	16	0
2	2	2
0	0	0
0	0	0
0	0	0
4	4	3
10	7	5
18	14	7
4	2	1
12	9	3
2	0	0
0	0	0
3	1	0
4	2	2
14	10	6
5	4	3
12	9	2
1	1	0
0	0	0
489	352	70
N GE 100	NTS LT 1	TS LT 1

Added Histograms (N >= 100)
aCHH30/20/10
aCHV50/10
c1CVV40 (picture) TS=67 CS=34
c1KuHH80
c1KuVV20
c1SHH0
c1SHV0 (picture) TS=54 CS=47
c1SVV30,40
c3CHV20
c3CVV40/50
c3XHH40
c3XHV20
c3XVV30/40
c3SHH40
c3SVV30/40
c3KuHH30
c3KuVV20
c3XHV20
c3XHH40
cSVV40 (picture) TS=52 CS=40
cSHV60
cCVV40
cKuVV20
fKuHH50
fKuVV50
fKaHH50
fLHV0 (picture)
fSHV50
fSVV50,30,20
fCVV0
gCHV70
gCVV70
gSHH20, 50 (picture) TS=43 CS=41
gCHV30
gLHH50
gLVV50
Subtracted
c1CVV10 (picture) TS=77 CS=52
c1KuHH10
cCHH0 (picture) TS=57 CS=67
cSHH0

Total Samples per Terrain Type

soils	34291	10%
trees	3269	1%
grass	43013	12.4%
shrubs	107959	3[illegible]%
short veg.	134648	39%
roads	1195	0.3%
dry snow	11880	3.3%
wet snow	10341	3%

Some "success" rates for N >= 100
short veg. 78%
soils 75%
grasses 74 %
dry snow 72%
wet snow 69%
shrubs 66 %

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AL	HH0												
0	4.5	4.5	6.8	6.9	0.617	2.393	0	290.6	74.5	125.8	231	1.69	3.90
5	0.4	0.4	4.4	4.5	0.403	1.32	0	193.7	55.8	51.9	373	0.93	3.47
10	-4.2	-4.2	4.8	4.8	0.436	0.792	0	147.6	65.2	26.9	548	0.41	2.26
15	-7.3	-7.3	5.8	5.8	0.526	0.584	0	249.4	72.2	45.4	549	0.63	3.45
20	-9.3	-9.3	6.2	6.3	0.562	0.473	0	300.8	75.6	54.6	551	0.72	3.98
25	-10.4	-10.4	5.5	5.5	0.499	0.402	0	59.3	56.9	41.7	142	0.73	1.04
30	-13.9	-13.9	5.9	5.9	0.535	0.274	0	133.5	67.5	38.3	349	0.57	1.98
35	-13.6	-13.6	5.7	5.7	0.517	0.281	0	75.3	58.1	53.4	141	0.92	1.30
40	-15.4	-15.4	5.1	5.1	0.463	0.222	0	46.3	54.6	31.3	148	0.57	0.85
45	-18.6	-18.6	4.3	4.3	0.39	0.147	0	47.4	48.6	33.6	141	0.69	0.98
50	-20.7	-20.7	4.6	4.6	0.417	0.117	0	120.3	53.4	58.1	207	1.09	2.25

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AL	HV0												
0	-16	-16	5.5	5.5	0.499	0.211	0	164.2	62.8	87.3	188	1.39	2.61
5	-18.3	-18.3	3.2	3.2	0.29	0.144	0	112	43.8	33.5	334	0.76	2.56
10	-23	-23.1	3.6	3.6	0.327	0.085	0	142.5	46.2	40.1	355	0.87	3.08
15	-25.2	-25.2	5	5	0.454	0.071	0	108.6	61.7	29.6	367	0.48	1.76
20	-26	-26	5.2	5.2	0.472	0.066	0	94.4	66.3	23.8	397	0.36	1.42
25	-26.4	-26.4	4	4	0.363	0.059	0	45.8	46.2	31.8	144	0.69	0.99
30	-28.9	-28.9	5.2	5.2	0.472	0.047	0	79.4	60.5	24.7	322	0.41	1.31
35	-27.4	-27.4	4.6	4.6	0.417	0.054	0	48.2	48.6	33.7	143	0.69	0.99
40	-27.9	-27.9	4.2	4.2	0.381	0.05	0	74.8	47.4	50.2	149	1.06	1.58
45	-29.6	-29.6	3.6	3.6	0.327	0.04	0	42.7	42.6	29.7	144	0.70	1.00
50	-31.2	-31.2	4.6	4.6	0.417	0.035	0	49.2	53.4	27.5	179	0.51	0.92

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AL	VV0												
0	4.9	4.9	6.5	6.6	0.59	2.467	0	232.9	73.3	101.2	230	1.38	3.18
5	1.2	1.2	4.4	4.4	0.399	1.444	0	92.1	53.4	40.1	230	0.75	1.72
10	-3.6	-3.6	4.5	4.5	0.408	0.835	0	97.5	58.1	23.8	409	0.41	1.68
15	-7.9	-7.9	5.2	5.2	0.472	0.528	0	65.5	66.3	16.1	406	0.24	0.99
20	-10.4	-10.4	5.4	5.4	0.49	0.4	0	76.4	67.5	18.7	408	0.28	1.13
30	-14.7	-14.7	6.4	6.5	0.581	0.257	0	79.2	66.3	38.7	205	0.58	1.19
50	-19.5	-19.5	4.9	4.9	0.445	0.137	0	43.5	43.8	66.9	65	1.53	0.99

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AS	HH2												
0	2.6	2.6	7.5	7.5	0.708	1.975	0.02	353	73.3	133.7	264	1.82	4.82
5	-0.4	-0.4	5.9	5.9	0.556	1.277	0.02	72.9	62.8	39.2	186	0.62	1.16
10	-3.9	-3.9	4.7	4.7	0.449	0.795	0.02	71.3	58.1	16.1	442	0.28	1.23
15	-6.2	-6.2	4.5	4.5	0.436	0.599	0.02	64.8	59.3	17.9	361	0.30	1.09
20	-9	-9	4.5	4.5	0.448	0.428	0.02	106	59.3	24	442	0.40	1.79
30	-12.2	-12.2	5.1	5.1	0.535	0.299	0.02	151.8	61.7	57.5	264	0.93	2.46
40	-15.8	-15.8	5.7	5.7	0.657	0.196	0.02	40.2	54.6	49.1	82	0.90	0.74
50	-19.2	-19.2	2.2	2.2	0.254	0.103	0.02	11.5	18.3	71.9	16	3.93	0.63

udmod0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AS	VV0												
0	2.4	2.4	7.5	7.6	0.68	1.95	0	405.5	73.3	153.6	264	2.10	5.53
5	-0.9	-0.9	5.7	5.8	0.518	1.214	0	80.2	60.5	43.1	186	0.71	1.33
10	-4	-4	4.7	4.7	0.426	0.806	0	87.9	60.5	19.9	441	0.33	1.45
15	-6.4	-6.4	4.7	4.7	0.426	0.611	0	72.4	60.5	20	362	0.33	1.20
20	-9	-9	4.6	4.6	0.417	0.451	0	129	61.7	29.2	442	0.47	2.09
30	-12.6	-12.6	5.2	5.2	0.472	0.307	0	265.3	58.1	100.9	263	1.74	4.57
40	-14.2	-14.2	4.9	4.9	0.445	0.252	0	34.2	47.4	41.7	82	0.88	0.72
50	-17.8	-17.8	3	3	0.272	0.151	0	24.2	19.7	151.2	16	7.68	1.23

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
BK	UHH5												
0	-9.8	-9.8	4.2	4.2	0.49	0.35	0.05	36.5	42.6	55.3	66	1.30	0.86
10	-9.8	-9.8	4.5	4.5	0.53	0.356	0.05	43	43.8	61.5	70	1.40	0.98
20	-10.9	-10.9	4	4	0.481	0.299	0.05	47.2	37.7	73.8	64	1.96	1.25
30	-12.3	-12.3	4.1	4.1	0.523	0.247	0.05	67.8	40.1	104.3	65	2.60	1.69
40	-12.8	-12.8	3.5	3.5	0.446	0.223	0.05	79	37.7	112.8	70	2.99	2.10
50	-13.3	-13.3	2.8	2.8	0.356	0.199	0.05	40.4	28.9	61.2	66	2.12	1.40
60	-14.3	-14.3	2.7	2.7	0.359	0.171	0.05	25.9	30.1	37	70	1.23	0.86
70	-16.7	-16.7	2.6	2.6	0.4	0.116	0.05	21.3	31.4	33.3	64	1.06	0.68
80	-16.2	-16.2	2.6	2.6	0.386	0.126	0.05	29.2	30.1	50.3	58	1.67	0.97

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
BK	UHV5												
0	-11.2	-11.2	3.4	3.4	0.406	0.277	0.05	21.4	37.7	33.4	64	0.89	0.57
10	-11.4	-11.4	4	4	0.49	0.279	0.05	45.2	38.9	70.7	64	1.82	1.16
20	-12.2	-12.2	3.3	3.3	0.408	0.24	0.05	27	32.7	42.3	64	1.29	0.83
30	-13.2	-13.2	3	3	0.383	0.204	0.05	21.1	35.2	32.9	64	0.93	0.60
40	-14	-14	2.5	2.5	0.325	0.176	0.05	15.4	31.4	24	64	0.76	0.49
50	-14.2	-14.2	2.1	2.1	0.272	0.167	0.05	36.5	26.3	62.9	58	2.39	1.39
60	-15.2	-15.2	2	2	0.272	0.142	0.05	8.4	27.6	13.1	64	0.47	0.30
70	-17.7	-17.7	2.8	2.8	0.476	0.098	0.05	20.9	30.1	36	58	1.20	0.69
80	-17.6	-17.6	2	2	0.322	0.095	0.05	17.9	23.7	30.9	58	1.30	0.76

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
BK	UVV5												
0	-9.6	-9.6	4.2	4.2	0.487	0.36	0.05	43.2	42.6	65.5	66	1.54	1.01
10	-9.6	-9.6	4.5	4.5	0.527	0.365	0.05	38.3	42.6	54.8	70	1.29	0.90
20	-10.3	-10.3	3.9	3.9	0.459	0.322	0.05	37.3	38.9	54	69	1.39	0.96
30	-11.5	-11.5	4.1	4.1	0.506	0.277	0.05	64.2	38.9	89.2	72	2.29	1.65
40	-12	-12	3.6	3.6	0.446	0.251	0.05	70.1	37.7	87.6	80	2.32	1.86
50	-12.5	-12.5	2.8	2.8	0.344	0.223	0.05	57.2	30.1	74.2	77	2.47	1.90
60	-14	-14	2.5	2.5	0.325	0.176	0.05	27.4	27.6	39.1	70	1.42	0.99
70	-16.4	-16.4	2.7	2.7	0.408	0.123	0.05	16.7	31.4	26.1	64	0.83	0.53
80	-16.1	-16.1	2.6	2.6	0.383	0.128	0.05	27.2	30.1	46.8	58	1.55	0.90

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
BX	HV5												
0	-11.4	-11.4	3.2	3.2	0.382	0.267	0.05	34.1	35.2	55.9	59	1.59	0.97
10	-10.9	-10.9	3.5	3.5	0.415	0.29	0.05	30.2	37.7	51.3	59	1.36	0.80
20	-12	-12	2.9	2.9	0.351	0.241	0.05	14.8	32.7	22.8	61	0.70	0.45
30	-13	-13	2.4	2.4	0.297	0.203	0.05	17.6	28.9	26.6	62	0.92	0.61
40	-14.8	-14.8	3.9	3.9	0.563	0.169	0.05	77	40.1	101.4	72	2.53	1.92
60	-15.5	-15.5	2	2	0.276	0.136	0.05	11.1	25	17.1	65	0.68	0.44
70	-16.7	-16.7	2.7	2.7	0.419	0.116	0.05	16.1	32.7	27.3	59	0.83	0.49
80	-16.8	-16.8	2.1	2.1	0.318	0.11	0.05	10.7	26.3	17.8	60	0.68	0.41

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
BX	VV5												
0	-8.4	-8.4	4	4	0.447	0.416	0.05	39.2	36.4	75.4	50	2.07	1.08
10	-8	-8	4.3	4.3	0.479	0.446	0.05	29	37.7	57.9	50	1.54	0.77
20	-9.7	-9.7	3.7	3.7	0.425	0.345	0.05	40.9	37.7	71.7	53	1.90	1.08
30	-10.4	-10.4	3.5	3.5	0.408	0.311	0.05	46.5	35.2	81.5	53	2.32	1.32
40	-11.6	-11.6	3.6	3.6	0.439	0.265	0.05	53.1	38.9	83	60	2.13	1.37
50	-13	-13	3.2	3.2	0.407	0.213	0.05	46.6	32.7	61.3	76	1.87	1.43
60	-13.7	-13.7	2.7	2.7	0.349	0.186	0.05	24.4	31.4	39.4	62	1.25	0.78
70	-14.7	-14.7	3.8	3.8	0.542	0.171	0.05	74.2	38.9	134.9	55	3.47	1.91
80	-13.5	-13.5	2.5	2.5	0.317	0.19	0.05	18.3	25	41.7	44	1.67	0.73

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
CC	HH0												
0	3.6	3.6	5.6	5.6	0.508	2.027	0	132.1	65.2	47	281	0.72	2.03
10	-2.7	-2.7	5.5	5.5	0.499	0.976	0	103.8	66.3	33.2	313	0.50	1.57
20	-9.1	-9.1	4.7	4.7	0.426	0.448	0	147.2	60.5	50.4	292	0.83	2.43
30	-10.9	-10.9	3.9	3.9	0.354	0.349	0	217	54.6	51.7	420	0.95	3.97
40	-12.9	-12.9	3	3	0.272	0.265	0	44.5	41.3	24.2	184	0.59	1.08
60	-12.4	-12.4	2.5	2.5	0.227	0.273	0	39.8	36.4	21.4	186	0.59	1.09
80	-13.9	-13.9	3	3	0.272	0.236	0	47.2	40.1	27.5	172	0.69	1.18

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
CC	HV3												
0	-8.7	-8.7	4.4	4.4	0.456	0.431	0.03	51.4	58.1	19.8	259	0.34	0.88
10	-12.7	-12.7	5.4	5.4	0.624	0.274	0.03	87.5	68.7	32.5	269	0.47	1.27
20	-15.4	-15.4	5.9	5.9	0.762	0.196	0.03	166.9	71	62.5	267	0.88	2.35
30	-17.1	-17.1	5.1	5.1	0.69	0.148	0.03	143.8	65.2	36.4	395	0.56	2.21
40	-17.5	-17.5	3.5	3.5	0.452	0.129	0.03	46.9	47.4	26.3	178	0.55	0.99
60	-18.5	-18.5	2.7	2.7	0.355	0.106	0.03	23.7	38.9	12.9	184	0.33	0.61
80	-21	-21	4	4	0.657	0.077	0.03	71.1	48.6	41.3	172	0.85	1.46

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
CC	VV0												
0	3.8	3.8	5.8	5.8	0.526	2.095	0	101.2	67.5	36.1	280	0.53	1.50
10	-1.7	-1.7	5.5	5.5	0.499	1.095	0	85	65.2	30.4	280	0.47	1.30
20	-7.8	-7.8	4.4	4.4	0.399	0.512	0	63.2	56.9	22.6	279	0.40	1.11
30	-10.7	-10.7	3.9	3.9	0.354	0.358	0	123.6	54.6	31.2	396	0.57	2.26
40	-10.6	-10.6	2.5	2.5	0.227	0.336	0	114.6	33.9	66.6	172	1.96	3.38
60	-12.6	-12.6	2.5	2.5	0.227	0.267	0	32.7	35.2	17.8	184	0.51	0.93
80	-15.6	-15.6	3.8	3.8	0.345	0.202	0	65.2	46.2	37.9	172	0.82	1.41

IA CK	Mean UHH0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-0.1	-0.1	3.7	3.8	0.339	1.201	0	221.2	48.6	41.7	530	0.86	4.55
10	-3.4	-3.4	4.2	4.2	0.381	0.842	0	508.4	52.2	77.6	655	1.49	9.74
20	-6.6	-6.6	2.7	2.7	0.245	0.538	0	289	46.2	43.5	664	0.94	6.26
30	-8.8	-8.8	2.6	2.6	0.236	0.416	0	157.8	43.8	23.7	666	0.54	3.60
40	-11.5	-11.5	3.1	3.1	0.281	0.313	0	354.4	48.6	26.6	1334	0.55	7.29
50	-12.9	-12.9	3.1	3.1	0.281	0.266	0	276.7	48.6	32.9	841	0.68	5.69
60	-13.1	-13.1	2.6	2.6	0.236	0.253	0	236.6	40.1	17.9	1325	0.45	5.90
70	-14	-14	2.6	2.6	0.236	0.228	0	203.1	36.4	26.6	764	0.73	5.58
80	-15.3	-15.3	2.1	2.1	0.191	0.192	0	231.4	36.4	46	503	1.26	6.36

IA CK	Mean UVV5	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	0.8	0.8	4	4	0.388	1.299	0.05	175.5	54.6	33	531	0.60	3.21
10	-3.3	-3.3	4	4	0.406	0.791	0.05	443.7	51	67.5	657	1.32	8.70
20	-7.6	-7.6	2.9	2.9	0.31	0.434	0.05	492.8	48.6	73.8	668	1.52	10.14
30	-10.2	-10.2	3	3	0.343	0.31	0.05	187.1	47.4	27.8	672	0.59	3.95
40	-13.2	-13.2	3.7	3.7	0.485	0.212	0.05	129.6	54.6	9.7	1339	0.18	2.37
50	-14.6	-14.6	3.7	3.7	0.522	0.173	0.05	154.4	51	18.2	849	0.36	3.03
60	-13.9	-13.9	3.5	3.5	0.471	0.19	0.05	252.2	47.4	19.2	1311	0.41	5.32
70	-14.1	-14.1	3.6	3.6	0.492	0.185	0.05	137.9	47.4	18	767	0.38	2.91
80	-13.7	-13.7	2.4	2.4	0.307	0.183	0.05	137.8	40.1	26.9	512	0.67	3.44

IA CL	Mean HH1	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	8.1	8.1	5.2	5.2	0.475	3.322	0.01	46.9	54.6	33.3	141	0.61	0.86
5	1.8	1.8	5.5	5.5	0.507	1.629	0.01	42.1	47.4	71.3	59	1.50	0.89
10	-6.1	-6.1	4.3	4.3	0.403	0.61	0.01	33	52.2	18.5	178	0.35	0.63
15	-11.6	-11.6	4.4	4.4	0.424	0.321	0.01	64.3	40.1	109	59	2.72	1.60
20	-15.6	-15.6	5.5	5.5	0.559	0.211	0.01	129.1	59.3	75.9	170	1.28	2.18
30	-19.3	-19.3	5.7	5.7	0.618	0.135	0.01	130.4	58.1	78.5	166	1.35	2.24
40	-21.2	-21.2	6.1	6.1	0.698	0.109	0.01	109.3	61.7	96.7	113	1.57	1.77
50	-21.1	-21.1	9.8	9.8	1.263	0.131	0.01	64.5	37.7	174.2	37	4.62	1.71
60	-24	-24	5.8	5.8	0.719	0.074	0.01	110.8	59.3	105.5	105	1.78	1.87
80	-29.3	-29.3	3.1	3.1	0.444	0.03	0.01	17.2	37.7	20.1	86	0.53	0.46

IA CL	Mean HV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-14.2	-14.2	4.7	4.7	0.426	0.249	0	90.3	47.4	86.8	104	1.83	1.91
10	-22.4	-22.4	4.2	4.2	0.381	0.094	0	99.5	47.4	80.2	124	1.69	2.10
20	-29.9	-29.9	4.8	4.8	0.435	0.041	0	131.7	49.8	108	122	2.17	2.64
30	-31.4	-31.4	5.1	5.1	0.463	0.035	0	78.2	51	64.1	122	1.26	1.53
40	-33.8	-33.8	3.8	3.8	0.345	0.025	0	33.1	38.9	36	92	0.93	0.85
60	-36	-36	3.5	3.5	0.318	0.019	0	37.1	37.7	43.1	86	1.14	0.98
80	-37.6	-37.6	3.7	3.7	0.336	0.016	0	32	41.3	37.2	86	0.90	0.77

IA CL	Mean VV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	8	8	5.7	5.7	0.517	3.381	0	70.8	59.3	50.2	141	0.85	1.19
10	-5.2	-5.2	3.7	3.7	0.336	0.667	0	66.1	43.8	46.9	141	1.07	1.51
20	-15	-15	5	5	0.454	0.231	0	153.8	53.4	94.9	162	1.78	2.88
30	-18.6	-18.6	5.8	5.8	0.526	0.159	0	231.4	55.8	142.8	162	2.56	4.15
40	-21.6	-21.6	6.7	6.8	0.608	0.118	0	179.3	60.5	170.7	105	2.82	2.96
50	-23.7	-23.7	6.9	6.9	0.622	0.093	0	125.6	27.6	433.2	29	15.70	4.55
60	-25.1	-25.2	6.1	6.1	0.553	0.076	0	225	54.6	212.2	106	3.89	4.12
80	-27.7	-27.7	2.9	2.9	0.263	0.048	0	22.5	35.2	26.2	86	0.74	0.64

IA CS	Mean HH3	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	5.7	5.7	6.4	6.4	0.601	2.661	0.03	87	65.2	63.1	138	0.97	1.33
5	1.7	1.7	5.7	5.7	0.544	1.604	0.03	68.2	43.8	148.2	46	3.38	1.56
10	-5.2	-5.2	4.7	4.7	0.467	0.671	0.03	52.1	54.6	38	137	0.70	0.95
15	-10	-10	4.3	4.3	0.454	0.364	0.03	42.7	40.1	92.8	46	2.31	1.06
20	-12.8	-12.8	4.2	4.2	0.471	0.254	0.03	63.4	49.8	45.9	138	0.92	1.27
30	-15.9	-15.9	3.6	3.6	0.437	0.162	0.03	57.1	42.6	41.4	138	0.97	1.34
40	-16.7	-16.7	3.3	3.3	0.409	0.142	0.03	18.4	36.4	21.4	86	0.59	0.51
60	-18.4	-18.4	3.4	3.4	0.457	0.112	0.03	36.5	40.1	42.4	86	1.06	0.91
80	-20.2	-20.2	3.5	3.5	0.528	0.085	0.03	36.2	41.3	42.1	86	1.02	0.88

IA CS	Mean HV3	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-12.4	-12.4	4	4	0.442	0.264	0.03	66.3	47.4	54.3	122	1.15	1.40
5	-15.1	-15.1	4.1	4.2	0.497	0.187	0.03	24.8	31.4	92	27	2.93	0.79
10	-19.4	-19.4	4.4	4.4	0.658	0.101	0.03	43.1	52.2	33.2	130	0.64	0.83
15	-21.9	-21.9	4.5	4.6	0.842	0.066	0.03	27.2	40.1	69.8	39	1.74	0.68
20	-23	-23	4.5	4.5	0.936	0.053	0.03	41.4	49.8	31.4	132	0.63	0.83
30	-24.2	-24.2	3.8	3.8	0.884	0.04	0.03	53.7	42.6	40.7	132	0.96	1.26
40	-25.2	-25.2	3	3	0.769	0.031	0.03	25.2	35.2	29.3	86	0.83	0.72
60	-27.4	-27.4	3	3	1.348	0.013	0.03	54.5	28.9	63.4	86	2.19	1.89
80	-27.7	-27.7	3.4	3.4	1.725	0.01	0.03	39.6	32.7	46.1	86	1.41	1.21

IA CS	Mean VV3	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	5.8	5.8	6.6	6.6	0.62	2.72	0.03	92.8	67.5	67.2	138	1.00	1.37
5	2.1	2.1	5.9	5.9	0.562	1.695	0.03	66.6	43.8	144.7	46	3.30	1.52
10	-4.4	-4.4	4.9	4.9	0.484	0.747	0.03	40.5	55.8	29.4	138	0.53	0.73
15	-9.1	-9.1	4.5	4.6	0.475	0.415	0.03	38	40.1	82.6	46	2.06	0.95
20	-12	-12	4.5	4.5	0.498	0.286	0.03	36.3	52.2	26.5	137	0.51	0.70
30	-15.7	-15.7	3.8	3.8	0.46	0.169	0.03	51.4	42.6	37.3	138	0.88	1.21
40	-17.3	-17.3	3.2	3.2	0.405	0.13	0.03	24.8	35.2	28.9	86	0.82	0.70
60	-19.4	-19.4	3.2	3.2	0.452	0.095	0.03	30.6	38.9	35.6	86	0.92	0.79
80	-20.7	-20.7	3.4	3.4	0.529	0.078	0.03	29	40.1	33.8	86	0.84	0.72

udmod0

IA CX	Mean HH0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	0.8	0.8	4.4	4.4	0.399	1.379	0	54.4	55.8	22.9	238	0.41	0.97
10	-1.8	-1.8	4.8	4.8	0.436	1.044	0	422.1	62.8	122.3	345	1.95	6.72
20	-6.3	-6.3	3.1	3.1	0.281	0.569	0	375.3	47.4	99.6	377	2.10	7.92
30	-8.8	-8.8	2.6	2.6	0.236	0.416	0	141.5	41.3	27.4	516	0.66	3.43
40	-11.7	-11.7	3.1	3.1	0.281	0.306	0	130.6	51	14	931	0.27	2.56
45	-12.5	-12.5	3.2	3.2	0.289	0.28	0	60.1	25	146.6	41	5.86	2.40
50	-12.8	-12.8	3.1	3.1	0.281	0.269	0	68.8	48.6	7.7	890	0.16	1.42
60	-13.2	-13.2	2.8	2.8	0.254	0.253	0	218.1	48.6	21.1	1033	0.43	4.49
70	-14.7	-14.7	3.1	3.1	0.281	0.216	0	215.3	51	29.6	728	0.58	4.22
80	-15.5	-15.5	3.5	3.5	0.317	0.201	0	192.8	47.4	79.7	242	1.68	4.07

IA CX	Mean VV5	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	1.2	1.2	4.4	4.4	0.428	1.393	0.05	70	56.9	29.5	237	0.52	1.23
10	-2.5	-2.5	5	5	0.51	0.921	0.05	396.1	59.3	115.5	343	1.95	6.68
20	-7.7	-7.7	3.1	3.1	0.334	0.433	0.05	393	46.2	84.3	466	1.82	8.51
30	-11.1	-11.1	2.8	2.8	0.327	0.271	0.05	154.3	38.9	30.3	510	0.78	3.97
40	-14.2	-14.2	3.6	3.6	0.495	0.182	0.05	104.2	54.6	11.2	928	0.21	1.91
50	-13.8	-13.8	3.8	3.8	0.515	0.196	0.05	87	52.2	6.4	1366	0.12	1.67
60	-14.5	-14.5	3.5	3.5	0.487	0.173	0.05	109.9	49.8	11.2	979	0.22	2.21
70	-14.8	-14.8	3.7	3.7	0.529	0.167	0.05	69.2	53.4	9.5	729	0.18	1.30
80	-14.6	-14.6	3.8	3.8	0.538	0.174	0.05	207.5	49.8	87.9	236	1.77	4.17

IA DC	Mean HH5	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-0.9	-0.9	4.7	4.8	0.471	1.102	0.05	1419.8	52.2	176.4	805	3.38	27.20
10	-3.7	-3.7	4.3	4.3	0.441	0.766	0.05	244.9	60.5	20.8	1176	0.34	4.05
20	-8.1	-8.1	3.3	3.3	0.36	0.416	0.05	396.8	48.6	38.2	1040	0.79	8.16
30	-9.7	-9.7	3.1	3.1	0.35	0.334	0.05	462.9	51	49.3	939	0.97	9.08
40	-12	-12	2.4	2.4	0.286	0.234	0.05	161.8	33.9	29.3	553	0.86	4.77
50	-13	-13	2.9	2.9	0.365	0.209	0.05	79.2	46.2	12.3	643	0.27	1.71
60	-13.8	-13.8	1.9	1.9	0.24	0.175	0.05	80.4	28.9	15.3	524	0.53	2.78
80	-18	-18	1.8	1.8	0.297	0.087	0.05	54.7	31.4	10.8	505	0.34	1.74

IA DC	Mean HV5	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-12.5	-12.5	4.8	4.8	0.636	0.249	0.05	578.8	54.6	79	733	1.45	10.60
10	-14.6	-14.6	3.8	3.8	0.538	0.174	0.05	637.5	49.8	77.4	824	1.55	12.80
20	-16	-16	3.4	3.4	0.519	0.136	0.05	603.6	52.2	60.8	993	1.16	11.56
30	-16.5	-16.5	3.4	3.4	0.539	0.125	0.05	344.6	49.8	38.9	886	0.78	6.92
40	-17.7	-17.7	2.3	2.3	0.38	0.095	0.05	49.7	33.9	9.1	549	0.27	1.47
50	-18.1	-18.1	3.4	3.4	0.624	0.094	0.05	208.1	47.4	32.6	638	0.69	4.39
60	-18.5	-18.5	1.9	1.9	0.33	0.08	0.05	77.1	30.1	14.8	520	0.49	2.56
80	-22	-22	2.1	2.1	0.651	0.035	0.05	31.3	32.7	6.2	503	0.19	0.96

DK UHH5

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-1.8	-1.8	5.2	5.2	0.527	1.014	0.05	1531.1	54.6	206.3	742	3.78	28.04
10	-1.5	-1.5	5.7	5.7	0.58	1.08	0.05	3012.2	72.2	232.1	1298	3.21	41.72
20	-4.9	-4.9	3.1	3.1	0.318	0.618	0.05	1449.5	43.8	111.2	1303	2.54	33.09
30	-6.2	-6.2	2.2	2.2	0.227	0.499	0.05	581.8	41.3	44.6	1304	1.08	14.09
40	-7.6	-7.6	2.2	2.2	0.233	0.417	0.05	486.9	37.7	16.3	2985	0.43	12.92
50	-8.4	-8.4	2.2	2.2	0.236	0.376	0.05	801	35.2	29.5	2715	0.84	22.76
60	-9.5	-9.5	2.4	2.4	0.266	0.329	0.05	547.6	38.9	18.3	2991	0.47	14.08
70	-11.2	-11.2	2.2	2.2	0.254	0.258	0.05	113.8	37.7	5.1	2231	0.14	3.02
80	-14.4	-14.4	2	2	0.26	0.161	0.05	90.8	31.4	13.2	687	0.42	2.89

DK UHV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
40	-11.1	-11.1	2.3	2.3	0.209	0.314	0	465.9	33.9	27.4	1702	0.81	13.74
50	-11.9	-11.9	2.4	2.4	0.218	0.288	0	105	45	6.1	1715	0.14	2.33
60	-12.9	-12.9	2.3	2.3	0.209	0.255	0	417.9	36.4	24.9	1677	0.68	11.48
70	-14.8	-14.8	2.2	2.2	0.2	0.204	0	241.3	36.4	15.6	1549	0.43	6.63

DK UVV5

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-1	-1	5.1	5.1	0.513	1.112	0.05	1920.4	58.1	257.8	745	4.44	33.05
10	-1.3	-1.3	5.3	5.3	0.535	1.083	0.05	3736.4	67.5	277.2	1348	4.11	55.35
20	-4.5	-4.5	3	3	0.305	0.646	0.05	788.3	47.4	58.3	1353	1.23	16.63
30	-5.8	-5.8	2.3	2.3	0.236	0.528	0.05	294.4	43.8	21.7	1354	0.50	6.72
40	-7.4	-7.4	2.4	2.4	0.254	0.433	0.05	367	41.3	12.1	3034	0.29	8.89
50	-8.4	-8.4	2.4	2.4	0.259	0.38	0.05	376.4	42.6	13.6	2763	0.32	8.84
60	-9.6	-9.6	2.5	2.5	0.278	0.326	0.05	989.5	40.1	33	2995	0.82	24.68
70	-11.5	-11.5	2.4	2.4	0.281	0.251	0.05	547.2	38.9	24.4	2240	0.63	14.07
80	-14.1	-14.1	2.1	2.1	0.271	0.169	0.05	246.5	37.7	36.5	676	0.97	6.54

DL HH3

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	1.3	1.3	5.1	5.1	0.485	1.485	0.03	436.2	60.5	110.2	396	1.82	7.21
10	-7.5	-7.5	5.5	5.5	0.57	0.53	0.03	162.9	60.5	38.1	427	0.63	2.69
20	-12.5	-12.5	6.7	6.7	0.801	0.301	0.03	202.7	72.2	46	441	0.64	2.81
30	-15	-15	6.5	6.5	0.845	0.213	0.03	146.2	71	33.2	440	0.47	2.06
40	-19.4	-19.4	5.7	5.7	0.909	0.107	0.03	145.7	61.7	52.2	279	0.85	2.36
60	-23.8	-23.8	4.5	4.5	1.041	0.044	0.03	138.9	52.2	57.4	242	1.10	2.66
80	-25.3	-25.3	2.4	2.4	0.592	0.03	0.03	24.9	33.9	11.2	223	0.33	0.73

DL HV1

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-22.9	-22.9	3.6	3.6	0.403	0.076	0.01	249.4	43.8	102.2	244	2.33	5.69
10	-24.1	-24.1	4.8	4.8	0.578	0.069	0.01	133.9	53.4	38.1	351	0.71	2.51
20	-24.8	-24.8	5.7	5.7	0.726	0.066	0.01	119.1	64	31.5	378	0.49	1.86
30	-25.4	-25.4	5.5	5.5	0.714	0.06	0.01	80.6	59.3	21.3	378	0.36	1.36
40	-28.4	-28.4	4.4	4.4	0.633	0.037	0.01	70	54.6	26	269	0.48	1.28
60	-31	-31	3.5	3.5	0.582	0.023	0.01	51.6	45	23.2	223	0.52	1.15
80	-32.7	-32.7	2.6	2.6	0.485	0.016	0.01	38.3	37.7	17.3	221	0.46	1.02

IA DS	Mean HH5	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-0.2	-0.2	4.8	4.9	0.479	1.206	0.05	466.4	60.5	117.5	397	1.94	7.71
10	-7.2	-7.2	4.2	4.2	0.458	0.491	0.05	113.3	51	28.5	397	0.56	2.22
20	-11.7	-11.7	3.5	3.5	0.427	0.26	0.05	106	45	26.7	397	0.59	2.36
30	-13.5	-13.5	3.2	3.2	0.417	0.198	0.05	90.2	48.6	22.7	386	0.47	1.86
40	-16.7	-16.7	2.4	2.4	0.367	0.114	0.05	87.2	33.9	34.8	251	1.03	2.57
60	-18.5	-18.5	2.3	2.3	0.41	0.082	0.05	30.6	33.9	12.2	251	0.36	0.90
80	-20	-20	2	2	0.421	0.059	0.05	18.8	30.1	7.5	251	0.25	0.62

IA DS	Mean HV3	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-18.8	-18.8	4	4	0.565	0.109	0.03	233.8	47.4	74.2	315	1.57	4.93
10	-20.1	-20.1	3.7	3.7	0.558	0.088	0.03	105.6	48.6	27	391	0.56	2.17
20	-21	-21	3.3	3.3	0.522	0.074	0.03	126.9	47.4	32.5	391	0.69	2.68
30	-21.4	-21.4	3	3	0.482	0.068	0.03	77.1	38.9	20	386	0.51	1.98
40	-23.4	-23.4	2.3	2.3	0.432	0.045	0.03	42	32.7	16.7	251	0.51	1.28
60	-24.8	-24.8	1.9	1.9	0.414	0.033	0.03	32.3	28.9	12.9	251	0.45	1.12
80	-27.9	-27.9	1.8	1.8	0.838	0.012	0.03	121.6	26.3	48.5	251	1.84	4.62

IA DS	Mean VV5	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-0.3	-0.3	4.9	5	0.49	1.198	0.05	352.5	59.3	89.2	395	1.50	5.94
10	-6.8	-6.8	4	4	0.43	0.511	0.05	207	49.8	52.1	397	1.05	4.16
20	-11.6	-11.6	2.9	2.9	0.346	0.255	0.05	176.9	46.2	44.6	397	0.97	3.83
30	-13.3	-13.3	2.5	2.5	0.315	0.195	0.05	208.7	38.9	52.8	395	1.36	5.37
40	-15	-15	2.7	2.7	0.373	0.153	0.05	123.9	36.4	49.3	251	1.35	3.40
60	-16.2	-16.2	2.7	2.7	0.404	0.126	0.05	26.5	38.9	10.6	251	0.27	0.68
80	-19.2	-19.2	2.6	2.6	0.512	0.073	0.05	72.2	35.2	28.8	251	0.82	2.05

IA DX	Mean HH3	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-2.9	-2.9	5.3	5.3	0.519	0.913	0.03	1105.4	53.4	182.4	606	3.42	20.70
10	-2.1	-2.1	6.1	6.1	0.599	1.048	0.03	3125.6	60.5	290.8	1075	4.81	51.66
20	-6	-6	3.1	3.1	0.305	0.559	0.03	1096	37.7	98.6	1111	2.62	29.07
30	-7.3	-7.3	2.3	2.3	0.228	0.456	0.03	790.9	37.7	65.8	1202	1.75	20.98
40	-9.2	-9.2	2.1	2.1	0.212	0.357	0.03	1791.6	36.4	71	2523	1.95	49.22
50	-10.4	-10.4	2.5	2.5	0.258	0.314	0.03	331.7	48.6	12.9	2569	0.27	6.83
60	-11.2	-11.2	2.5	2.5	0.262	0.283	0.03	905	38.9	34.6	2616	0.89	23.26
70	-13.2	-13.2	2.4	2.4	0.261	0.217	0.03	310.7	41.3	16.1	1930	0.39	7.52
80	-15.7	-15.7	1.6	1.6	0.183	0.148	0.03	103.3	27.6	17.1	605	0.62	3.74

IA DX	Mean VV5	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-2.7	-2.7	5.2	5.2	0.534	0.909	0.05	786.3	53.4	128.9	610	2.41	14.72
10	-2.2	-2.2	6	6	0.619	1.008	0.05	2872.5	61.7	267.5	1074	4.34	46.56
20	-6	-6	3	3	0.312	0.535	0.05	1275.4	42.6	105.7	1207	2.48	29.94
30	-7.5	-7.5	2.2	2.2	0.232	0.422	0.05	609.6	41.3	50.9	1198	1.23	14.76
40	-9.2	-9.2	2.1	2.1	0.229	0.336	0.05	1402.5	40.1	55.6	2521	1.39	34.98
50	-9.7	-9.7	2.8	2.8	0.314	0.328	0.05	171.1	48.6	4.6	3684	0.09	3.52
60	-11.5	-11.5	2.2	2.2	0.257	0.248	0.05	312.7	36.4	12.2	2565	0.34	8.59
70	-13.3	-13.3	2.4	2.4	0.301	0.194	0.05	298.2	41.3	15.5	1929	0.38	7.22
80	-16.6	-16.6	1.7	1.7	0.249	0.111	0.05	83.4	28.9	13.9	601	0.48	2.89

IA EC	Mean HH3	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	0.3	0.3	6.2	6.2	0.596	1.398	0.03	627.9	67.5	57.8	1086	0.86	9.30
10	-3.5	-3.5	4.6	4.6	0.45	0.819	0.03	437.6	67.5	29.4	1489	0.44	6.48
20	-8.3	-8.3	3.7	3.7	0.377	0.436	0.03	382.1	61.7	28.7	1332	0.47	6.19
30	-10.1	-10.1	3.4	3.4	0.354	0.343	0.03	639.1	56.9	47	1359	0.83	11.23
40	-12.2	-12.2	2.6	2.6	0.278	0.251	0.03	102.4	43.8	13.9	737	0.32	2.34
50	-14	-14	3.3	3.3	0.373	0.206	0.03	120.2	54.6	12.2	986	0.22	2.20
60	-13.4	-13.4	2.2	2.2	0.239	0.21	0.03	126.4	37.7	17.8	710	0.47	3.35
80	-17	-17	2.8	2.8	0.345	0.133	0.03	470.9	45	69.6	677	1.55	10.46

IA EC	Mean HV5	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-11.5	-11.5	5	5	0.638	0.29	0.05	304.4	64	30.7	992	0.48	4.76
10	-14.1	-14.1	4.3	4.3	0.606	0.192	0.05	385.7	61.7	35.3	1093	0.57	6.25
20	-15.9	-15.9	4.1	4.1	0.644	0.143	0.05	549.5	58.1	43.6	1260	0.75	9.46
30	-16.7	-16.7	4	4	0.665	0.125	0.05	410.4	55.8	32	1281	0.57	7.35
40	-17.7	-17.7	2.6	2.6	0.436	0.097	0.05	67.1	41.3	9.2	727	0.22	1.62
50	-19.1	-19.1	3.9	3.9	0.832	0.078	0.05	1103.2	53.4	113.6	971	2.13	20.66
60	-18.5	-18.5	2.2	2.2	0.389	0.082	0.05	61.3	36.4	8.7	704	0.24	1.68
80	-21.8	-21.8	2.7	2.7	0.835	0.038	0.05	125.4	38.9	18.6	675	0.48	3.22

IA EC	Mean VV5	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	0.3	0.3	5.1	5.2	0.509	1.302	0.05	1584.1	64	146.9	1078	2.30	24.75
10	-4.2	-4.2	4.5	4.5	0.467	0.728	0.05	923.4	64	85.3	1082	1.33	14.43
20	-8.2	-8.2	3.5	3.5	0.384	0.415	0.05	336.7	56.9	31.1	1083	0.55	5.92
30	-10	-10	3.3	3.3	0.378	0.324	0.05	330.7	55.8	25.8	1283	0.46	5.93
40	-11.3	-11.3	2.3	2.3	0.267	0.256	0.05	616.9	35.2	91.4	675	2.60	17.53
60	-13.1	-13.1	2.1	2.1	0.259	0.196	0.05	84.3	35.2	12.2	692	0.35	2.39
80	-17.1	-17.1	2.6	2.6	0.414	0.108	0.05	144.5	41.3	21.4	675	0.52	3.50

IA EK	Mean UHH5	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-1.1	-1.1	4.8	4.8	0.48	1.08	0.05	2318.9	55.8	182.3	1272	3.27	41.56
10	-2.1	-2.1	5.3	5.3	0.54	0.983	0.05	6159.4	69.8	315.4	1953	4.52	88.24
20	-5.4	-5.4	3.1	3.1	0.32	0.58	0.05	1402.4	55.8	71.3	1967	1.28	25.13
30	-7.1	-7.1	2.7	2.7	0.285	0.457	0.05	277.3	49.8	14.1	1970	0.28	5.57
40	-8.8	-8.8	3.1	3.1	0.342	0.376	0.05	108.7	58.1	2.5	4319	0.04	1.87
50	-9.5	-9.5	3.1	3.1	0.348	0.342	0.05	118.9	55.8	3.3	3556	0.06	2.13
60	-10.6	-10.6	3	3	0.347	0.294	0.05	148.5	51	3.4	4316	0.07	2.91
70	-11.9	-11.9	2.6	2.6	0.311	0.24	0.05	198.1	43.8	6.6	2995	0.15	4.52
80	-14.8	-14.8	2.1	2.1	0.28	0.152	0.05	395.6	38.9	33.2	1190	0.85	10.17

IA EK	Mean UHV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
40	-12.5	-12.5	3.5	3.5	0.318	0.285	0	98.8	56.9	4.2	1702	0.07	1.74
50	-13.3	-13.3	3.5	3.5	0.318	0.26	0	74.8	64	3.2	1715	0.05	1.17
60	-14	-14	3.2	3.2	0.29	0.236	0	121.2	51	5.3	1677	0.10	2.38
70	-15.4	-15.4	2.8	2.8	0.254	0.197	0	108.9	45	5.2	1549	0.12	2.42

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
EK	UVV0												
0	-0.3	-0.3	4.3	4.4	0.392	1.21	0	2987.4	54.6	234.1	1276	4.29	54.71
10	-1.9	-1.9	5	5	0.454	1.043	0	10632	64	530.3	2005	8.29	166.13
20	-5.5	-5.5	3.3	3.3	0.299	0.63	0	1561.2	60.5	77.2	2021	1.28	25.80
30	-7.2	-7.2	3.3	3.3	0.299	0.518	0	180	58.1	8.9	2026	0.15	3.10
40	-9.2	-9.2	3.9	3.9	0.354	0.425	0	172	62.8	3.9	4373	0.06	2.74
50	-9.9	-9.9	3.8	3.8	0.345	0.39	0	261.6	58.1	7.2	3612	0.12	4.50
60	-10.9	-10.9	3.5	3.5	0.317	0.342	0	414.3	52.2	9.6	4306	0.18	7.94
70	-12.1	-12.1	3	3	0.272	0.29	0	501.2	46.2	16.7	3007	0.36	10.85
80	-13.9	-13.9	2.3	2.3	0.209	0.228	0	424.6	42.6	35.7	1188	0.84	9.97

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
EL	HH5												
0	3.1	3.1	5.9	5.9	0.574	1.892	0.05	395.8	68.7	73.7	537	1.07	5.76
10	-7.1	-7.1	5.2	5.2	0.58	0.526	0.05	111.9	62.8	18.5	605	0.29	1.78
20	-13.4	-13.4	6.5	6.5	0.974	0.235	0.05	153.8	76.8	25.2	611	0.33	2.00
30	-16.2	-16.2	6.6	6.6	1.221	0.146	0.05	92.6	71	15.3	606	0.22	1.30
40	-19.9	-19.9	5.9	5.9	1.633	0.059	0.05	88.2	62.8	22.5	392	0.36	1.40
60	-22.1	-22.1	4.9	4.9	1.98	0.025	0.05	95.7	53.4	27.6	347	0.52	1.79
80	-23.8	-23.8	3.2	3.2	1.97	0.011	0.05	79.9	28.9	25.9	309	0.90	2.76

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
EL	HV1												
0	-20.3	-20.3	5.6	5.6	0.619	0.119	0.01	324.6	60.5	93.3	348	1.54	5.37
10	-23.7	-23.7	4.7	4.7	0.555	0.073	0.01	189.6	59.3	39.9	475	0.67	3.20
20	-26	-26	5.9	5.9	0.801	0.056	0.01	137.7	72.2	27.5	500	0.38	1.91
30	-26.8	-26.8	6	6	0.852	0.05	0.01	82.7	68.7	16.5	500	0.24	1.20
40	-29.6	-29.6	4.9	4.9	0.787	0.031	0.01	49.4	59.3	13.7	361	0.23	0.83
60	-32.2	-32.2	4.2	4.2	0.82	0.019	0.01	82.3	51	26.6	309	0.52	1.61
80	-34.2	-34.2	3.6	3.6	0.881	0.012	0.01	125.4	46.2	40.8	307	0.88	2.71

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
EL	VV3												
0	2.7	2.7	5.8	5.8	0.55	1.816	0.03	595.6	73.3	110.9	537	1.51	8.13
10	-7.2	-7.2	4.8	4.8	0.49	0.529	0.03	166	60.5	31.7	523	0.52	2.74
20	-14	-14	4.8	4.8	0.566	0.224	0.03	166.4	64	29.7	560	0.46	2.60
30	-16.6	-16.6	5	5	0.656	0.159	0.03	88.7	64	15.9	559	0.25	1.39
40	-19.6	-19.6	5.5	5.5	0.88	0.103	0.03	98.7	65.2	28.9	341	0.44	1.51
60	-21.6	-21.6	5.5	5.5	1.05	0.071	0.03	86.2	62.8	24.8	347	0.39	1.37
80	-23.5	-23.5	4	4	0.858	0.047	0.03	88.1	46.2	28.5	309	0.62	1.91

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
ES	HH5												
0	1.3	1.3	5.9	5.9	0.583	1.528	0.05	347.9	80.2	65	535	0.81	4.34
10	-6.7	-6.7	4.4	4.4	0.477	0.529	0.05	165.6	64	31	534	0.48	2.59
20	-12	-12	3.7	3.7	0.46	0.252	0.05	101.3	55.8	18.9	535	0.34	1.82
30	-14.1	-14.1	3.4	3.4	0.46	0.183	0.05	64.9	52.2	12.1	535	0.23	1.24
40	-16.7	-16.7	2.7	2.7	0.419	0.116	0.05	47.2	38.9	14	337	0.36	1.21
60	-18.5	-18.5	2.6	2.6	0.471	0.084	0.05	38.5	37.7	11.4	337	0.30	1.02
80	-20.1	-20.1	2.5	2.5	0.551	0.06	0.05	23.3	36.4	6.9	337	0.19	0.64

IA ES	Mean HV3	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-17	-17	4.9	4.9	0.653	0.149	0.03	221.9	56.9	50.8	437	0.89	3.90
10	-19.9	-19.9	3.9	3.9	0.588	0.091	0.03	113.6	54.6	21.8	521	0.40	2.08
20	-21.5	-21.5	3.7	3.7	0.626	0.069	0.03	97.7	51	18.7	523	0.37	1.92
30	-22.1	-22.1	3.4	3.4	0.598	0.061	0.03	108.4	45	20.9	518	0.46	2.41
40	-23.8	-23.8	2.6	2.6	0.525	0.042	0.03	49.5	37.7	14.7	337	0.39	1.31
60	-25.4	-25.4	2.5	2.5	0.639	0.029	0.03	259.2	36.4	76.9	337	2.11	7.12
80	-28	-28	2.5	2.5	1.321	0.01	0.03	119.7	35.2	35.5	337	1.01	3.40

IA ES	Mean VV3	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	1.3	1.3	5.8	5.8	0.554	1.541	0.03	465.5	79.1	87.3	533	1.10	5.88
10	-6.2	-6.2	4.4	4.4	0.441	0.585	0.03	241.3	65.2	45.1	535	0.69	3.70
15	-8.9	-8.9	3.7	3.7	0.38	0.404	0.03	79	49.8	41.2	192	0.83	1.59
20	-11.7	-11.7	3.4	3.4	0.365	0.28	0.03	124.8	52.2	23.4	534	0.45	2.39
30	-13.9	-13.9	3.1	3.1	0.348	0.207	0.03	169.9	45	31.9	533	0.71	3.78
40	-15.6	-15.6	3	3	0.354	0.163	0.03	178.4	40.1	52.9	337	1.32	4.45
50	-16.6	-16.6	3.1	3.1	0.377	0.143	0.03	28.1	23.7	117.1	24	4.94	1.19
60	-17	-17	3.2	3.2	0.4	0.136	0.03	28.3	47.4	8.4	337	0.18	0.60
80	-19.6	-19.6	2.9	2.9	0.408	0.091	0.03	58.4	42.6	17.3	337	0.41	1.37

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AC	HH0												
0	1.6	1.6	8.1	8.2	0.735	1.834	0	2747.8	80.2	400.6	687	5.00	34.26
5	-1.3	-1.3	4.9	4.9	0.442	1.11	0	429.3	58.1	73.5	584	1.27	7.39
10	-2.9	-2.9	4.7	4.7	0.426	0.915	0	861.7	62.8	54	1596	0.86	13.72
15	-4.4	-4.4	4.6	4.6	0.417	0.766	0	270.5	66.3	28.8	939	0.43	4.08
20	-7.3	-7.3	4.5	4.5	0.408	0.546	0	566.7	64	47	1205	0.73	8.85
25	-8.8	-8.8	4.9	4.9	0.445	0.469	0	128.5	51	91.8	140	1.80	2.52
30	-10.5	-10.5	4.5	4.5	0.408	0.377	0	540.5	65.2	67.1	805	1.03	8.29
35	-12	-12	3.6	3.6	0.327	0.303	0	46.7	42.6	33.4	140	0.78	1.10
40	-13.2	-13.2	4.4	4.4	0.399	0.275	0	64.6	58.1	16.5	392	0.28	1.11
45	-13.4	-13.4	2.9	2.9	0.263	0.249	0	41.8	36.4	28.1	149	0.77	1.15
50	-14.4	-14.4	3.7	3.7	0.336	0.231	0	100	48.6	30.5	328	0.63	2.06

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AK	UHH0												
0	-0.3	-0.3	5.7	5.7	0.517	1.3	0	14.7	25	61.3	24	2.45	0.59
5	-2	-2	4.5	4.5	0.408	1.004	0	16.2	23.7	77.1	21	3.25	0.68
10	-4.3	-4.3	4.7	4.7	0.427	0.779	0	14	31.4	51.7	27	1.65	0.45
15	-4.9	-4.9	5.5	5.5	0.499	0.758	0	11.4	22.4	52	22	2.32	0.51
20	-7.8	-7.8	5.1	5.1	0.463	0.532	0	27.3	36.4	80.4	34	2.21	0.75
30	-11.2	-11.2	4	4	0.363	0.339	0	12.1	28.9	38	32	1.31	0.42
40	-11	-11	4.1	4.1	0.372	0.349	0	15.1	23.7	75.7	20	3.19	0.64
50	-14.2	-14.2	4.3	4.3	0.39	0.244	0	30.9	33.9	77.1	40	2.27	0.91
60	-14.2	-14.2	4.9	4.9	0.445	0.252	0	15.6	26.3	70.8	22	2.69	0.59

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AK	UVV5												
0	-1	-1	5.1	5.1	0.513	1.112	0.05	26.9	32.7	89.8	30	2.75	0.82
10	-0.8	-0.8	4.5	4.5	0.447	1.102	0.05	59	53.4	34.9	169	0.65	1.10
20	-4.2	-4.2	4.5	4.5	0.467	0.728	0.05	77.7	55.8	44.4	175	0.80	1.39
30	-7.2	-7.2	3.5	3.5	0.376	0.472	0.05	42.5	46.2	24.4	174	0.53	0.92
40	-8.5	-8.5	2.5	2.5	0.271	0.377	0.05	38.5	35.2	24.4	158	0.69	1.09
50	-10.2	-10.2	3.3	3.3	0.38	0.316	0.05	48.6	43.8	26.7	182	0.61	1.11
60	-12.7	-12.7	4.3	4.3	0.563	0.236	0.05	17.9	23.7	81.2	22	3.43	0.76

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AS	HV0												
0	-14.5	-14.5	5.5	5.5	0.499	0.251	0	136.2	56.9	52.8	258	0.93	2.39
10	-20.3	-20.3	4.2	4.2	0.381	0.12	0	122.6	52.2	39.4	311	0.75	2.35
20	-23.1	-23.1	4.6	4.6	0.417	0.089	0	191.2	58.1	48.7	393	0.84	3.29
30	-24.7	-24.7	5.7	5.7	0.517	0.078	0	160	64	60.6	264	0.95	2.50
40	-24.9	-24.9	6.7	6.8	0.608	0.081	0	47.2	55.8	59	80	1.06	0.85

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AX	HH0												
0	5	5	7.4	7.5	0.671	2.615	0	30.4	28.9	121.7	25	4.21	1.05
10	-1.6	-1.6	5.1	5.1	0.463	1.085	0	32.9	40.1	76.5	43	1.91	0.82
20	-4.8	-4.8	4.2	4.2	0.381	0.716	0	22.9	38.9	41.6	55	1.07	0.59
30	-8.1	-8.1	4.3	4.3	0.39	0.492	0	38.1	45	40.6	94	0.90	0.85
40	-9.1	-9.1	5.5	5.5	0.499	0.467	0	40	45	69	58	1.53	0.89
50	-10.8	-10.8	5.2	5.2	0.472	0.378	0	83.7	51	89	94	1.75	1.64
60	-16.3	-16.3	6.4	6.5	0.581	0.214	0	113.2	60.5	89.9	126	1.49	1.87
70	-15.2	-15.2	6.3	6.4	0.571	0.241	0	41.5	48.6	72.9	57	1.50	0.85
80	-17.4	-17.4	5.6	5.6	0.508	0.181	0	10	32.7	37	27	1.13	0.31

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
BX	HH5												
0	-8.5	-8.5	4.2	4.2	0.472	0.415	0.05	54.1	38.9	102	52	2.62	1.39
10	-8.3	-8.3	4.4	4.4	0.495	0.431	0.05	36.2	38.9	69.6	52	1.79	0.93
20	-9.8	-9.8	4	4	0.464	0.346	0.05	42.1	40.1	75.1	54	1.87	1.05
30	-10.4	-10.4	3.5	3.5	0.408	0.311	0.05	49.7	36.4	82.8	58	2.27	1.37
40	-11.6	-11.6	3.6	3.6	0.439	0.265	0.05	41.5	37.7	61.9	65	1.64	1.10
50	-12.1	-12.1	3.4	3.4	0.42	0.244	0.05	79.7	35.2	93.8	85	2.66	2.26
60	-12.9	-12.9	3.6	3.6	0.463	0.221	0.05	24.9	37.7	33.6	74	0.89	0.66
70	-14	-14	4.2	4.2	0.586	0.194	0.05	50.7	45	75.7	66	1.68	1.13
80	-13.5	-13.5	2.9	2.9	0.374	0.194	0.05	37.7	32.7	69.8	53	2.13	1.15

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
DC	VV5												
0	-0.9	-0.9	4.7	4.8	0.471	1.102	0.05	1478.4	54.6	185.3	798	3.39	27.08
10	-5.1	-5.1	3.8	3.8	0.395	0.626	0.05	576.5	49.8	71.9	802	1.44	11.58
20	-8.4	-8.4	3.1	3.1	0.339	0.396	0.05	414.2	45	51.5	993	1.14	9.20
30	-9.7	-9.7	2.9	2.9	0.326	0.33	0.05	403.5	48.6	45.5	887	0.94	8.30
40	-11.5	-11.5	2.2	2.2	0.257	0.248	0.05	360.9	33.9	71.8	503	2.12	10.65
50	-12.9	-12.9	2.3	2.3	0.283	0.204	0.05	57.8	28.9	52.1	111	1.80	2.00
60	-13.2	-13.2	1.9	1.9	0.234	0.191	0.05	152.2	30.1	30	508	1.00	5.06
80	-17.6	-17.6	1.8	1.8	0.286	0.094	0.05	130.1	27.6	25.9	503	0.94	4.71

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
DL	VV5												
0	0.8	0.8	4.2	4.3	0.414	1.317	0.05	483	59.3	122	396	2.06	8.15
10	-7.9	-7.9	5	5	0.565	0.469	0.05	113.8	59.3	29.8	382	0.50	1.92
20	-13.5	-13.5	4.6	4.6	0.636	0.213	0.05	67.2	54.6	16.9	398	0.31	1.23
30	-15.8	-15.8	4.4	4.4	0.696	0.148	0.05	53.2	55.8	13.4	397	0.24	0.95
40	-18.7	-18.7	4.5	4.5	0.95	0.086	0.05	80.1	52.2	33.9	236	0.65	1.53
60	-20.1	-20.1	4.4	4.4	1.125	0.061	0.05	88.7	51	36.8	241	0.72	1.74
80	-21.9	-21.9	3.2	3.2	1.059	0.036	0.05	68.1	36.4	30.5	223	0.84	1.87

IA HX	Mean HH3	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	8.6	8.6	3.3	3.3	0.304	3.166	0.03	51.8	36.4	44.3	117	1.22	1.42
10	-4.5	-4.5	2.2	2.2	0.212	0.638	0.03	14.8	23.7	41.2	36	1.74	0.62
20	-7.6	-7.6	2	2	0.198	0.432	0.03	48.5	28.9	42.6	114	1.47	1.68
30	-10.2	-10.2	2.4	2.4	0.247	0.32	0.03	16.2	25	54	30	2.16	0.65
40	-9.4	-9.4	2.7	2.7	0.275	0.36	0.03	53.2	27.6	96.8	55	3.51	1.93
50	-12.1	-12.1	2.9	2.9	0.311	0.258	0.03	118.1	41.3	37.4	316	0.91	2.86
60	-15.9	-15.9	4.2	4.2	0.52	0.168	0.03	6.7	19.7	39.2	17	1.99	0.34
70	-16.9	-16.9	3	3	0.371	0.136	0.03	24.9	36.4	30.3	82	0.83	0.68

IA IC	Mean HH3	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	8	8	3.9	3.9	0.36	3.047	0.03	40	43.8	28.4	141	0.65	0.91
10	-9.1	-9.1	4.4	4.4	0.459	0.41	0.03	53.4	48.6	55.1	97	1.13	1.10
20	-12.5	-12.5	4	4	0.443	0.261	0.03	50.9	51	34.4	148	0.67	1.00
30	-15	-15	4.1	4.1	0.489	0.189	0.03	28.5	47.4	27.9	102	0.59	0.60
50	-18.4	-18.4	4.5	4.5	0.635	0.119	0.03	94.8	53.4	44.3	214	0.83	1.78
70	-22.6	-22.6	4.4	4.4	0.864	0.058	0.03	68.9	49.8	49.9	138	1.00	1.38

IA IC	Mean HV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-6.1	-6.1	5.4	5.4	0.49	0.657	0	78.7	49.8	92.6	85	1.86	1.58
10	-20.7	-20.7	4.1	4.1	0.372	0.114	0	35.2	45	38.3	92	0.85	0.78
20	-21.8	-21.8	4.1	4.1	0.372	0.101	0	51.3	45	41.7	123	0.93	1.14
30	-24.2	-24.2	3.9	3.9	0.354	0.076	0	44.4	42.6	44.4	100	1.04	1.04
50	-26.3	-26.3	4.7	4.7	0.426	0.062	0	60.4	52.2	44.1	137	0.84	1.16
70	-28.1	-28.1	4.1	4.1	0.372	0.049	0	71	43.8	61.7	115	1.41	1.62

IA IC	Mean VV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	7.6	7.6	4.5	4.5	0.408	3.032	0	53.4	46.2	41	130	0.89	1.16
10	-9.5	-9.5	4.2	4.2	0.381	0.417	0	65.2	45	67.3	97	1.50	1.45
20	-12.5	-12.5	4.2	4.2	0.381	0.295	0	42.4	47.4	34.2	124	0.72	0.89
30	-15.6	-15.6	3.7	3.7	0.336	0.201	0	41.7	42.6	40.1	104	0.94	0.98
50	-18.9	-18.9	4.6	4.6	0.417	0.144	0	40.2	53.4	23.5	171	0.44	0.75
70	-22.2	-22.2	4.6	4.6	0.417	0.099	0	57.2	46.2	55.5	103	1.20	1.24

IA IS	Mean HH0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	8.2	8.2	4	4	0.363	3.166	0	59.3	42.6	59.9	99	1.41	1.39
10	-7.3	-7.3	3.7	3.7	0.336	0.523	0	39.3	36.4	70.1	56	1.93	1.08
20	-12.3	-12.3	3.6	3.6	0.327	0.293	0	53.6	38.9	53.6	100	1.38	1.38
30	-15.8	-15.8	3.9	3.9	0.354	0.199	0	32.8	38.9	54.6	60	1.40	0.84
50	-19.6	-19.6	3.2	3.2	0.29	0.124	0	63.2	41.3	43	147	1.04	1.53
70	-26	-26	3.1	3.1	0.281	0.059	0	30.1	37.7	31	97	0.82	0.80

IA IS	Mean HV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-10.3	-10.3	4.3	4.3	0.39	0.382	0	42.4	41.3	67.4	63	1.63	1.03
10	-21.1	-21.1	3.5	3.5	0.318	0.106	0	8.1	33.9	15.6	52	0.46	0.24
20	-23.2	-23.2	3.4	3.4	0.308	0.083	0	41.9	40.1	47.7	88	1.19	1.04
30	-25.9	-25.9	2.8	2.8	0.254	0.059	0	16.1	31.4	28.3	57	0.90	0.51
50	-28.9	-28.9	3.5	3.5	0.318	0.043	0	32	41.3	26.9	119	0.65	0.77
70	-33.5	-33.5	3.2	3.2	0.29	0.025	0	28.2	35.2	34.3	82	0.97	0.80

IA IS	Mean VV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	8.2	8.2	4	4	0.363	3.166	0	32	42.6	35.2	91	0.83	0.75
10	-7.1	-7.1	3.8	3.8	0.345	0.538	0	23.6	37.7	42.1	56	1.12	0.63
20	-11.6	-11.6	3.7	3.7	0.336	0.319	0	24.2	40.1	26.6	91	0.66	0.60
30	-15.1	-15.1	3.1	3.1	0.281	0.207	0	23.7	32.7	40.1	59	1.23	0.72
50	-19.4	-19.4	2.8	2.8	0.254	0.124	0	20.1	36.4	16.1	125	0.44	0.55
70	-25.3	-25.3	2.6	2.6	0.236	0.062	0	22.4	33.9	22.9	98	0.68	0.66

IA AC	Mean HV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-12.2	-12.2	6.6	6.7	0.599	0.346	0	835.9	67.5	134.2	688	1.99	12.38
5	-14.3	-14.3	4.6	4.6	0.417	0.245	0	203.7	56.9	38.4	584	0.67	3.58
10	-16.4	-16.4	4.9	4.9	0.444	0.195	0	752.3	59.3	79.4	1596	1.34	12.69
15	-17.3	-17.3	4.9	4.9	0.444	0.176	0	341.7	62.8	47.3	939	0.75	5.44
20	-19.3	-19.3	5.2	5.2	0.472	0.142	0	50087.3	67.5	5039	1205	74.65	742.03
25	-21.3	-21.3	4	4	0.363	0.106	0	40.4	46.2	28.2	140	0.61	0.87
30	-21.3	-21.3	5.6	5.6	0.508	0.115	0	185.9	81.4	23.6	805	0.29	2.28
35	-23.1	-23.1	4.2	4.2	0.381	0.087	0	59	46.2	41.5	140	0.90	1.28
40	-23	-23	5.7	5.7	0.517	0.095	0	103.1	73.3	26.7	392	0.36	1.41
45	-24.2	-24.2	3.9	3.9	0.354	0.076	0	52	46.2	34.4	149	0.74	1.13
50	-23.6	-23.6	4.9	4.9	0.444	0.085	0	778.1	55.8	265.6	328	4.76	13.94

IA AX	Mean HV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-9.3	-9.3	3.8	3.8	0.345	0.418	0	12.2	22.4	64.4	19	2.88	0.54
15	-14.1	-14.1	4.1	4.2	0.375	0.244	0	16.8	18.3	93.2	309	5.09	0.92
20	-16.2	-16.2	4.3	4.3	0.39	0.194	0	16.6	31.4	55.4	55	1.76	0.53
30	-18.6	-18.6	4.6	4.6	0.417	0.149	0	20.9	42.6	35.5	94	0.83	0.49
40	-19.5	-19.5	4.8	4.8	0.435	0.136	0	23.9	25	104.1	58	4.16	0.96
50	-20.3	-20.3	4.8	4.8	0.435	0.124	0	130.8	53.4	99.8	94	1.87	2.45
60	-23.9	-23.9	4.6	4.6	0.417	0.081	0	35.4	31.4	122.1	126	3.89	1.13
70	-25.1	-25.2	6.1	6.1	0.553	0.076	0	32.7	21	172.2	57	8.20	1.56

IA CX	Mean HV5	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
20	-16.5	-16.5	3.2	3.2	0.501	0.124	0.05	20.8	41.3	13.6	153	0.33	0.50
30	-20.3	-20.3	3.5	3.5	0.868	0.058	0.05	41.8	42.6	20.8	201	0.49	0.98
40	-17.3	-17.3	3.3	3.3	0.555	0.109	0.05	82.6	47.4	13.6	607	0.29	1.74
50	-18.9	-18.9	3.7	3.7	0.759	0.081	0.05	254.4	51	20.5	1244	0.40	4.99
60	-18.7	-18.7	3.3	3.3	0.644	0.083	0.05	67.4	46.2	10	671	0.22	1.46
70	-19.1	-19.1	3.3	3.3	0.673	0.077	0.05	45.2	46.2	7	643	0.15	0.98

IA DK	Mean AVV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
10	-6.9	-6.9	3.4	3.4	0.308	0.539	0	12.1	15.5	80.7	15	5.21	0.78
20	-6.1	-6.1	2.7	2.7	0.245	0.57	0	12.5	25	38.9	32	1.56	0.50
30	-6.8	-6.8	2.5	2.5	0.227	0.521	0	17.4	23.7	56.2	31	2.37	0.73
40	-8.1	-8.1	2.5	2.5	0.227	0.448	0	26.1	22.4	93.1	38	4.16	1.17
50	-8.6	-8.6	2.1	2.1	0.191	0.415	0	23.4	32.7	10	233	0.31	0.72
60	-10.3	-10.3	2.2	2.2	0.2	0.343	0	41.1	22.4	124.4	33	5.55	1.83
70	-11.9	-11.9	2.4	2.4	0.218	0.288	0	17.9	21	59.5	30	2.83	0.85

IA DX	Mean HV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
20	-15.5	-15.5	3.1	3.1	0.281	0.197	0	84.1	42.6	49.2	171	1.15	1.97
30	-17.2	-17.2	4	4	0.363	0.17	0	47.5	47.4	29.7	160	0.63	1.00
40	-13.2	-13.2	2.2	2.2	0.2	0.245	0	82.1	38.9	5.6	1478	0.14	2.11
50	-16	-16	4.2	4.2	0.381	0.197	0	207.3	72.2	7.7	2690	0.11	2.87
60	-15.3	-15.3	2.4	2.4	0.218	0.195	0	68.4	43.8	4.5	1528	0.10	1.56
70	-17.3	-17.3	2.5	2.5	0.227	0.155	0	159.3	38.9	10.7	1492	0.28	4.10

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/	TS/
EX	HH5											OACHI	OACHI
0	-1.8	-1.8	5.3	5.3	0.538	1.019	0.05	629.7	65.2	74.6	844	1.14	9.66
10	-2.1	-2.1	5.8	5.8	0.596	1.01	0.05	3548	74.5	249.9	1420	3.35	47.62
20	-6.1	-6.1	3.1	3.1	0.324	0.531	0.05	1886.9	53.4	126.8	1488	2.37	35.34
30	-7.8	-7.8	2.5	2.5	0.267	0.413	0.05	717.2	47.4	41.7	1718	0.88	15.13
40	-9.9	-9.9	2.7	2.7	0.304	0.317	0.05	226.6	51	6.6	3454	0.13	4.44
50	-11	-11	2.9	2.9	0.339	0.277	0.05	124.8	54.6	3.6	3459	0.07	2.29
60	-11.8	-11.8	2.7	2.7	0.322	0.245	0.05	1807.9	52.2	49.5	649	0.95	34.63
70	-13.6	-13.6	2.7	2.7	0.347	0.189	0.05	249	48.6	9.4	2658	0.19	5.12
80	-15.6	-15.6	2.3	2.3	0.324	0.136	0.05	275.7	38.9	32.5	847	0.84	7.09

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/	TS/
EX	VV5											OACHI	OACHI
0	-1.6	-1.6	5.3	5.3	0.536	1.044	0.05	938.8	61.7	110.8	847	1.80	15.22
10	-2.3	-2.3	5.8	5.8	0.598	0.986	0.05	2907.5	66.3	205.2	1417	3.10	43.85
20	-6.5	-6.5	3.1	3.1	0.326	0.505	0.05	1549.4	49.8	92.6	1673	1.86	31.11
30	-8.6	-8.6	2.9	2.9	0.317	0.381	0.05	223	47.4	13.1	1708	0.28	4.70
40	-10.6	-10.6	3.4	3.4	0.398	0.301	0.05	177.9	58.1	5.2	3449	0.09	3.06
50	-10.8	-10.8	3.6	3.6	0.427	0.296	0.05	143.8	58.1	2.8	5083	0.05	2.48
60	-12.3	-12.3	2.9	2.9	0.355	0.231	0.05	84	51	2.4	3544	0.05	1.65
70	-13.7	-13.7	2.9	2.9	0.377	0.189	0.05	268.8	51	10.1	2658	0.20	5.27
80	-16.1	-16.1	2.6	2.6	0.383	0.128	0.05	198.1	42.6	23.7	837	0.56	4.65

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/	TS/
HL	HV0											OACHI	OACHI
0	-12.6	-12.6	4.9	4.9	0.445	0.303	0	28.9	38.9	61.5	47	1.58	0.74
10	-23.3	-23.3	4.7	4.7	0.426	0.087	0	36.7	42.6	65.5	56	1.54	0.86
20	-28.6	-28.7	5.8	5.8	0.526	0.05	0	45.6	52.2	59.2	77	1.13	0.87
30	-34.3	-34.3	4.2	4.2	0.381	0.024	0	48.9	36.4	99.8	49	2.74	1.34
50	-33.7	-33.8	6.6	6.7	0.599	0.029	0	40.2	48.6	78.8	51	1.62	0.83
70	-39.1	-39.1	4.4	4.4	0.399	0.014	0	29.4	36.4	75.4	39	2.07	0.81

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/	TS/
HK	UHH0											OACHI	OACHI
0	8.9	8.9	3.4	3.4	0.308	3.325	0	50.3	41.3	22.3	225	0.54	1.22
10	-2.8	-2.8	2.6	2.6	0.236	0.83	0	42.2	32.7	49.1	86	1.50	1.29
20	-5.2	-5.2	2.8	2.8	0.254	0.636	0	39.2	40.1	17.8	220	0.44	0.98
30	-6	-6	3.6	3.6	0.327	0.605	0	23.5	40.1	29.4	80	0.73	0.59
40	-8.7	-8.7	2.6	2.6	0.236	0.421	0	31.3	31.4	34.8	90	1.11	1.00
50	-9.1	-9.1	3	3	0.272	0.41	0	296.7	45	56.7	523	1.26	6.59
70	-12.6	-12.6	3.4	3.4	0.308	0.28	0	57.2	45	31.1	184	0.69	1.27

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/	TS/
HW	VV0											OACHI	OACHI
0	2.2	2.2	2.7	2.7	0.245	1.483	0	13.4	19.7	74.3	18	3.77	0.68
10	-0.5	-0.5	4.2	4.3	0.384	1.177	0	17.6	26.3	80	22	3.04	0.67
20	-0.5	-0.5	3	3	0.269	1.102	0	20.7	26.3	76.6	27	2.91	0.79
30	-1.7	-1.7	3.9	3.9	0.354	1.008	0	11.3	23.7	59.3	19	2.50	0.48
40	-2.8	-2.9	3.7	3.7	0.336	0.874	0	206.6	33.9	382.5	54	11.28	6.09
55	-3.3	-3.3	2.2	2.2	0.2	0.767	0	11.9	19.7	49.5	24	2.51	0.60
70	-6.5	-6.5	3.3	3.3	0.299	0.562	0	15.3	19.7	85.1	18	4.32	0.78

IA IL	Mean HH0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	6.4	6.4	5.1	5.1	0.463	2.726	0	53.9	52.2	51.4	105	0.98	1.03
10	-8.1	-8.1	5	5	0.454	0.511	0	35.2	42.6	63.9	55	1.50	0.83
20	-14.8	-14.8	5.4	5.4	0.49	0.241	0	85.1	49.8	107.7	79	2.16	1.71
30	-20.1	-20.1	4.7	4.7	0.426	0.126	0	33.6	41.3	58	58	1.40	0.81
50	-22.9	-22.9	4.4	4.4	0.399	0.09	0	73.2	49.8	61	120	1.22	1.47
70	-28.7	-28.7	3.1	3.1	0.281	0.043	0	25	35.2	32.9	76	0.93	0.71

IA IL	Mean HV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-12	-12	5.2	5.2	0.472	0.329	0	17.5	40.1	42.6	41	1.06	0.44
10	-22.8	-22.8	5.1	5.1	0.463	0.095	0	24.8	41.3	49.7	50	1.20	0.60
20	-25.7	-25.7	6.1	6.1	0.553	0.071	0	51.1	53.4	70	73	1.31	0.96
30	-31.6	-31.6	3.8	3.8	0.345	0.032	0	28.8	35.2	61.4	47	1.74	0.82
50	-30.9	-30.9	4.9	4.9	0.445	0.037	0	40.8	46.2	56.7	72	1.23	0.88
70	-36.1	-36.1	3.7	3.7	0.336	0.019	0	15	32.7	36.6	41	1.12	0.46

IA IL	Mean VV2	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	6.7	6.7	4.4	4.4	0.405	2.7	0.02	33.2	46.2	35.7	93	0.77	0.72
10	-7.2	-7.2	5.6	5.6	0.555	0.564	0.02	50.1	46.2	89.4	56	1.94	1.08
20	-14.2	-14.2	5.4	5.4	0.593	0.237	0.02	73.8	52.2	94.6	78	1.81	1.41
30	-19.9	-19.9	4	4	0.502	0.103	0.02	25.8	41.3	44.5	58	1.08	0.62
50	-22.4	-22.4	4	4	0.567	0.072	0.02	60.9	46.2	58.6	104	1.27	1.32
70	-28.3	-28.3	3.4	3.4	0.841	0.023	0.02	23.9	37.7	29.5	81	0.78	0.63

IA IK	Mean AVV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	2.1	2.1	6.4	6.5	0.581	1.778	0	35.9	49.8	69	52	1.39	0.72
20	-2.8	-2.8	6.1	6.2	0.554	0.996	0	33.3	45	72.4	46	1.61	0.74
40	-4.5	-4.5	5.2	5.2	0.472	0.781	0	35.7	25	142.8	25	5.71	1.43
55	-7.1	-7.1	5	5	0.454	0.573	0	18.1	22.4	95.1	19	4.25	0.81

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AC	VV5												
0	2.1	2.1	8.4	8.4	0.856	1.921	0.05	952.6	89.4	139.7	682	1.56	10.66
10	-2.6	-2.6	4.8	4.8	0.488	0.9	0.05	419.6	66.3	39.9	1052	0.60	6.33
20	-7	-7	4.2	4.2	0.456	0.504	0.05	224.3	66.3	21.4	1047	0.32	3.38
30	-10.3	-10.3	4.5	4.5	0.539	0.333	0.05	182	65.2	27.7	657	0.42	2.79
40	-12.9	-12.9	4.2	4.2	0.553	0.228	0.05	59.6	55.8	24.1	247	0.43	1.07
50	-14.2	-14.2	3.6	3.6	0.495	0.182	0.05	35.2	43.8	29.6	119	0.68	0.80

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
AK	UHV0												
10	-18.6	-18.6	5.1	5.1	0.463	0.153	0	16.1	19.7	100.9	11	5.12	0.82
20	-20.1	-20.1	7.3	7.4	0.662	0.145	0	23.6	25	112.2	21	4.49	0.94
30	-24.2	-24.2	4.7	4.7	0.426	0.079	0	10.2	21	56.7	18	2.70	0.49
50	-22.5	-22.5	6.3	6.4	0.571	0.104	0	36.2	31.4	125	29	3.98	1.15

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
DK	AHH0												
20	-5.8	-5.8	2.9	2.9	0.263	0.597	0	14.8	26.3	51	29	1.94	0.56
30	-6.4	-6.4	3	3	0.272	0.56	0	20.2	26.3	69.6	29	2.65	0.77
40	-7.7	-7.7	2.9	2.9	0.263	0.479	0	12.2	25	48.7	25	1.95	0.49
50	-8.8	-8.8	2	2	0.181	0.403	0	44.8	31.4	19.5	230	0.62	1.43
60	-9.9	-9.9	2.7	2.7	0.245	0.368	0	21.4	23.7	73.8	29	3.11	0.90
70	-11.6	-11.6	2.9	2.9	0.263	0.306	0	10.2	25	35.2	29	1.41	0.41

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
HC	HV0												
0	-7.4	-7.4	6.7	6.8	0.608	0.605	0	48.7	61.7	48.7	100	0.79	0.79
10	-20.4	-20.4	4.1	4.1	0.372	0.118	0	51.8	46.2	45.1	115	0.98	1.12
20	-21.5	-21.5	4.1	4.1	0.372	0.104	0	60.9	46.2	42.9	142	0.93	1.32
30	-23.5	-23.5	3.4	3.4	0.308	0.08	0	38.4	40.1	33.1	116	0.83	0.96
50	-25.7	-25.7	4.6	4.6	0.417	0.066	0	46.5	51	31	150	0.61	0.91
70	-28.3	-28.3	4.2	4.2	0.381	0.048	0	108.4	43.8	75.8	143	1.73	2.47

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
IK	UHH0												
0	8.1	8.1	4.1	4.1	0.372	3.146	0	98	51	46.2	212	0.91	1.92
10	-3.8	-3.8	3.9	3.9	0.354	0.791	0	45.8	38.9	50.3	91	1.29	1.18
20	-8	-8	4.2	4.2	0.381	0.496	0	101.8	47.4	45.3	225	0.96	2.15
30	-8.2	-8.2	5.4	5.4	0.49	0.516	0	61.7	47.4	68.6	90	1.45	1.30
50	-14.3	-14.3	5.3	5.3	0.481	0.254	0	479.2	55.8	121.3	395	2.17	8.59
70	-15.4	-15.4	4.8	4.8	0.435	0.218	0	57.6	55.8	29.2	197	0.52	1.03

AK AHH0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
10	-6	-6	3.3	3.3	0.299	0.595	0	6.7	9.5	95.8	7	10.08	0.71
20	-6.3	-6.3	3	3	0.272	0.566	0	7.5	12.6	74.8	10	5.94	0.60
30	-6.8	-6.8	2.7	2.7	0.245	0.526	0	4.7	12.6	47.4	10	3.76	0.37
40	-8.3	-8.3	2.9	2.9	0.263	0.447	0	6.6	12.6	65.9	10	5.23	0.52
50	-10	-10	3.1	3.1	0.281	0.372	0	3.3	12.6	32.9	10	2.61	0.26
60	-11.7	-11.7	3.6	3.6	0.327	0.314	0	2.2	14.1	22	10	1.56	0.16
70	-14.7	-14.7	3.5	3.5	0.318	0.221	0	6.9	14.1	76.2	9	5.40	0.49
80	-15.5	-15.5	2.8	2.8	0.254	0.194	0	0.4	9.5	6.7	6	0.71	0.04

AK AVV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
10	-9.6	-9.6	5.6	5.6	0.508	0.443	0	7.7	16.9	64.3	12	3.80	0.46
20	-9.9	-9.9	5	5	0.453	0.415	0	8.8	19.7	59	15	2.99	0.45
30	-10	-10	5.1	5.1	0.463	0.413	0	16.4	19.7	109.1	15	5.54	0.83
40	-11.7	-11.7	4.9	4.9	0.445	0.336	0	14.6	19.7	97.2	15	4.93	0.74
50	-12.9	-12.9	4.9	4.9	0.444	0.292	0	10.1	18.3	67.2	15	3.67	0.55
60	-14.4	-14.4	4.9	4.9	0.445	0.246	0	3.5	16.9	23.4	15	1.38	0.21
70	-16.9	-16.9	4.9	4.9	0.444	0.184	0	6.8	18.3	48.9	14	2.67	0.37
80	-19.7	-19.7	5.5	5.5	0.499	0.138	0	3.9	11.1	48.5	8	4.37	0.35

BC HH0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-10.3	-10.3	1.6	1.6	0.145	0.332	0	0.2	6	5.5	4	0.92	0.03
20	-11	-11	2.6	2.6	0.236	0.323	0	2.5	12.6	27.7	7	2.20	0.20
40	-11	-11	2.5	2.5	0.227	0.321	0	4.9	9.5	61.8	6	6.51	0.52
55	-8.9	-8.9	0.7	0.7	0.063	0.372	0	179.9	11.1	153.7	117	13.85	16.21

BC HV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-16.3	-16.3	1.1	1.1	0.1	0.162	0	0.5	6	10.6	5	1.77	0.08
20	-17.1	-17.1	2.9	2.9	0.263	0.162	0	4.8	14.1	43.3	7	3.07	0.34
30	-16.5	-16.5	2	2	0.181	0.166	0	5.5	14.1	50.2	7	3.56	0.39
40	-17.4	-17.4	2.4	2.4	0.218	0.153	0	8.6	14.1	78.2	7	5.55	0.61
60	-22	-22	1.5	1.5	0.136	0.086	0	0.2	6	5.6	4	0.93	0.03
80	-24.8	-24.8	1.2	1.2	0.109	0.061	0	0.4	6	11	4	1.83	0.07

BC VV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-10.2	-10.2	1.7	1.7	0.154	0.338	0	0.9	6	18.7	5	3.12	0.15
20	-10.8	-10.8	2.8	2.8	0.254	0.334	0	5.9	14.1	53.6	7	3.80	0.42
40	-10.6	-10.6	2.3	2.3	0.209	0.333	0	6.2	12.6	61.8	7	4.90	0.49
80	-19	-19	1.5	1.5	0.136	0.121	0	1.2	6	29.4	4	4.90	0.20

BK AVV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
10	-10.6	-10.6	2.6	2.6	0.236	0.338	0	0.1	6	2.3	4	0.38	0.02
20	-11.2	-11.2	2.9	2.9	0.263	0.32	0	0.1	7.8	1.5	5	0.19	0.01
30	-12.1	-12.1	3.2	3.2	0.29	0.293	0	4.6	7.8	91.7	5	11.76	0.59
40	-12.7	-12.7	1.5	1.5	0.136	0.251	0	0.4	7.8	7.6	5	0.97	0.05
50	-15.2	-15.2	4.4	4.4	0.399	0.219	0	1.4	7.8	27.8	5	3.56	0.18
60	-15.5	-15.5	2.5	2.5	0.227	0.191	0	0.1	6	3.4	4	0.57	0.02

BL HV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
20	-16.7	-16.7	4.3	4.3	0.39	0.183	0	0	6	0.8	4	0.13	0.00
30	-18.7	-18.7	4.1	4.1	0.372	0.144	0	1.7	9.5	28.4	6	2.99	0.18
40	-20.7	-20.7	3.1	3.1	0.281	0.108	0	3.1	14.1	25.6	12	1.82	0.22
50	-19.2	-19.2	1.3	1.3	0.118	0.117	0	12.5	16.9	26.6	47	1.57	0.74
60	-18.8	-18.8	4.5	4.5	0.408	0.145	0	3.7	9.5	62.2	6	6.55	0.39

BL VV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
30	-13.1	-13.1	4.3	4.3	0.39	0.277	0	1.4	6	34.2	4	5.70	0.23
40	-14.5	-14.5	3.1	3.1	0.281	0.221	0	1	9.5	13.8	7	1.45	0.11
50	-10.9	-10.9	1.8	1.8	0.163	0.313	0	9.9	18.3	41.4	24	2.26	0.54
60	-16.9	-16.9	7.5	7.6	0.68	0.211	0	2	6	50.9	4	8.48	0.33

CK AHH5

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
10	-7	-7	2.5	2.5	0.263	0.458	0.05	7.9	19.7	41.5	19	2.11	0.40
20	-6.4	-6.4	3	3	0.315	0.509	0.05	17.8	28.9	46.9	38	1.62	0.62
30	-7.6	-7.6	2.8	2.8	0.299	0.431	0.05	21.8	28.9	57.5	38	1.99	0.75
40	-8.8	-8.8	2.9	2.9	0.319	0.371	0.05	8	28.9	24.9	32	0.86	0.28
50	-11	-11	3.4	3.4	0.403	0.285	0.05	25.5	36.4	49.1	52	1.35	0.70
60	-10.5	-10.5	3.1	3.1	0.359	0.299	0.05	21.2	28.9	55.8	38	1.93	0.73
70	-11.7	-11.7	3.3	3.3	0.4	0.257	0.05	15.5	32.7	40.8	38	1.25	0.47
80	-14.8	-14.8	3.8	3.8	0.546	0.168	0.05	3.5	16.9	23.4	15	1.38	0.21

CK AVV5

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
10	-7.7	-7.7	1.9	1.9	0.2	0.405	0.05	10.2	18.3	53.8	19	2.94	0.56
20	-7.1	-7.1	2.6	2.6	0.274	0.455	0.05	26.9	25	70.7	38	2.83	1.08
30	-7.9	-7.9	2.7	2.7	0.29	0.413	0.05	25.7	26.3	61.2	42	2.33	0.98
40	-9.3	-9.3	2.6	2.6	0.287	0.342	0.05	21	26.3	65.5	32	2.49	0.80
50	-11.4	-11.4	3.5	3.5	0.422	0.271	0.05	18.3	36.4	35.9	51	0.99	0.50
60	-10.8	-10.8	2.8	2.8	0.324	0.283	0.05	5.7	28.9	15.1	38	0.52	0.20
70	-12.4	-12.4	2.7	2.7	0.33	0.225	0.05	16.2	27.6	46.1	35	1.67	0.59
80	-15.4	-15.4	3	3	0.43	0.147	0.05	3.4	15.5	28.6	12	1.85	0.22

CK UHV5

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
40	-16.2	-16.2	3.2	3.2	0.49	0.13	0.05	119.4	47.4	18	662	0.38	2.52
50	-16.9	-16.9	3.3	3.3	0.538	0.116	0.05	102.3	47.4	15.8	648	0.33	2.16
60	-17	-17	3.4	3.4	0.561	0.115	0.05	72.1	47.4	12	601	0.25	1.52
70	-17.1	-17.1	3.4	3.4	0.566	0.113	0.05	44.7	43.8	8.2	544	0.19	1.02

CW VV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
10	-0.9	-0.9	1.1	1.1	0.1	0.955	0	0.9	6	22	4	3.67	0.15
20	-1.7	-1.7	1.7	1.7	0.154	0.898	0	0.6	6	15.7	4	2.62	0.10
30	-3.1	-3.1	2.2	2.2	0.2	0.785	0	0.7	6	16.9	4	2.82	0.12
40	-3	-3	1.2	1.2	0.109	0.754	0	0.4	6	8.8	4	1.47	0.07
50	-3	-3	1.9	1.9	0.172	0.781	0	1.8	6	45.2	4	7.53	0.30

IA EK	Mean AHH0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
10	-6.7	-6.7	3	3	0.272	0.541	0	15.4	26.3	48	32	1.83	0.59
20	-6.1	-6.1	3	3	0.272	0.579	0	17.6	31.4	26.3	67	0.84	0.56
30	-7	-7	2.9	2.9	0.263	0.52	0	27.2	31.4	40.5	67	1.29	0.87
40	-8.3	-8.3	2.9	2.9	0.263	0.447	0	18.8	31.4	33	57	1.05	0.60
50	-9.2	-9.2	2.5	2.5	0.227	0.395	0	37.5	40.1	13.3	282	0.33	0.94
60	-10.2	-10.2	3	3	0.272	0.361	0	37.1	33.9	55.4	67	1.63	1.09
70	-11.6	-11.6	3.1	3.1	0.281	0.309	0	32.5	35.2	48.4	67	1.38	0.92
80	-15.2	-15.2	3.9	3.9	0.354	0.213	0	8.5	27.6	34.1	25	1.24	0.31

IA EK	Mean AVV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-5	-5	5.5	5.5	0.499	0.749	0	2	6	49.9	4	8.32	0.33
10	-7.4	-7.4	2.7	2.7	0.245	0.491	0	32.1	25	94.5	34	3.78	1.28
20	-6.7	-6.7	2.7	2.7	0.245	0.532	0	57.6	27.6	82.2	70	2.98	2.09
30	-7.4	-7.4	2.6	2.6	0.236	0.489	0	44.2	28.9	60.6	73	2.10	1.53
40	-8.7	-8.7	2.6	2.6	0.236	0.421	0	39.7	30.1	66.2	60	2.20	1.32
50	-9.1	-9.1	2.7	2.7	0.245	0.404	0	38.7	41.3	13.6	284	0.33	0.94
60	-10.6	-10.6	2.5	2.5	0.227	0.336	0	34.7	31.4	48.8	71	1.55	1.11
70	-12.1	-12.1	2.6	2.6	0.236	0.284	0	15.5	28.9	23.9	65	0.83	0.54
80	-15.4	-15.4	2.3	2.3	0.209	0.191	0	6.6	21	28.8	23	1.37	0.31

IA FK	Mean AHH0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	17.3	17.3	10	10.1	0.907	12.34	0	10.1	11.1	126.1	8	11.36	0.91
10	-4.6	-4.6	2.7	2.7	0.245	0.678	0	19	25	73.2	26	2.93	0.76
20	-7.7	-7.7	3.1	3.1	0.281	0.484	0	8.1	26.3	31.2	26	1.19	0.31
30	-10.2	-10.2	3.5	3.5	0.318	0.371	0	12.5	26.3	47.9	26	1.82	0.48
40	-12.6	-12.6	4.2	4.2	0.381	0.292	0	13.6	28.9	52.3	26	1.81	0.47
50	-15.5	-15.5	4.8	4.8	0.436	0.216	0	40.1	30.1	154.1	26	5.12	1.33
60	-18.2	-18.2	4.7	4.7	0.426	0.157	0	17.7	28.9	70.6	25	2.44	0.61
70	-22.7	-22.7	5.1	5.1	0.463	0.096	0	19.2	28.9	80	24	2.77	0.66
80	-28.6	-28.6	5.6	5.6	0.508	0.05	0	6.6	18.3	50.9	13	2.78	0.36

IA FK	Mean AHV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
10	-15	-15	4.9	4.9	0.445	0.23	0	5.7	14.1	56.7	10	4.02	0.40
20	-16.2	-16.2	4.8	4.8	0.435	0.199	0	2.7	14.1	26.9	10	1.91	0.19
30	-17.3	-17.3	4.8	4.8	0.435	0.175	0	5.2	12.6	52.5	10	4.17	0.41
40	-18.6	-18.6	5.4	5.4	0.49	0.156	0	3.7	14.1	36.7	10	2.60	0.26
50	-20.1	-20.1	5.4	5.4	0.49	0.131	0	7.6	15.5	75.5	10	4.87	0.49
60	-20.2	-20.2	2.5	2.5	0.227	0.111	0	2.3	11.1	28.6	8	2.58	0.21
70	-24.2	-24.2	2.8	2.8	0.254	0.071	0	4.4	11.1	55.6	8	5.01	0.40

IA FK	Mean AVV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	16.5	16.5	10	10.1	0.907	11.254	0	11.1	14.1	111.3	10	7.89	0.79
10	-4.3	-4.3	2.8	2.8	0.254	0.705	0	14.1	25	54.3	26	2.17	0.56
20	-7.2	-7.2	3.6	3.6	0.327	0.527	0	11.8	27.6	45.2	26	1.64	0.43
30	-8.6	-8.6	3.1	3.1	0.281	0.437	0	12.7	26.3	48.7	26	1.85	0.48
40	-10	-10	3.5	3.5	0.318	0.38	0	23.4	27.6	89.9	26	3.26	0.85
50	-11.7	-11.7	3.6	3.6	0.327	0.314	0	31.5	27.6	121.3	26	4.39	1.14
60	-13.4	-13.4	3	3	0.272	0.25	0	26.8	25	111.5	24	4.46	1.07
70	-17.6	-17.6	4.5	4.5	0.408	0.167	0	16.4	27.6	68.1	24	2.47	0.59
80	-22	-22	3.2	3.2	0.29	0.094	0	7.3	15.5	55.9	13	3.61	0.47

IA FK	Mean UHH0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	18.5	18.5	9.8	9.9	0.889	14.066	0	8	12.6	100.2	8	7.95	0.63
10	-6.8	-6.8	5.1	5.1	0.462	0.596	0	13	19.7	72.2	18	3.66	0.66
20	-8.9	-8.9	5.2	5.2	0.472	0.471	0	9.2	21	51	18	2.43	0.44
30	-10	-10	5.7	5.7	0.517	0.426	0	18.4	22.4	102	18	4.55	0.82
40	-10.5	-10.5	5.5	5.5	0.499	0.398	0	8.2	21	45.6	18	2.17	0.39
50	-10.7	-10.7	6.6	6.7	0.599	0.412	0	8.5	23.7	47.4	18	2.00	0.36
60	-8.6	-8.6	5.6	5.6	0.508	0.497	0	4	21	24.7	16	1.18	0.19
70	-9	-9	9.4	9.5	0.853	0.579	0	8.6	19.7	53.9	16	2.74	0.44
80	-6	-6	13.9	14	1.261	1.034	0	7.8	14.1	64.8	12	4.60	0.55

IA FK	Mean UHV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
5	-9.5	-9.5	2.7	2.7	0.245	0.386	0	1.9	6	48.2	4	8.03	0.32
10	-13.5	-13.5	5.6	5.6	0.508	0.283	0	5.3	12.6	66.3	8	5.26	0.42
15	-15.3	-15.3	5.9	5.9	0.535	0.234	0	4.2	11.1	52.1	8	4.69	0.38
20	-16.5	-16.5	6.1	6.1	0.553	0.206	0	5.6	11.1	79.4	7	7.15	0.50
30	-18	-18	7.6	7.7	0.689	0.187	0	3.7	11.1	46.4	8	4.18	0.33
40	-19.8	-19.8	7.1	7.2	0.644	0.148	0	8.1	11.1	101.6	8	9.15	0.73
50	-22	-22	7.5	7.6	0.68	0.117	0	4	12.6	50.3	8	3.99	0.32
60	-21.1	-21.1	2.7	2.7	0.245	0.101	0	2.7	7.8	45	6	5.77	0.35
70	-25.7	-25.7	3.2	3.2	0.29	0.061	0	2.4	9.5	39.6	6	4.17	0.25

IA FK	Mean UVV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	18.6	18.6	9.6	9.7	0.871	14.066	0	17.4	12.6	217.2	8	17.24	1.38
10	-7.2	-7.2	5.5	5.5	0.499	0.581	0	16.1	21	89.6	18	4.27	0.77
20	-9.2	-9.2	5.3	5.3	0.481	0.457	0	8.1	21	45.1	18	2.15	0.39
30	-10	-10	5.7	5.7	0.517	0.426	0	3.9	22.4	21.4	18	0.96	0.17
40	-10.6	-10.6	5.5	5.5	0.499	0.393	0	6	22.4	33.3	18	1.49	0.27
50	-10.5	-10.5	5.8	5.8	0.526	0.404	0	16.5	22.4	91.6	18	4.09	0.74
60	-8.5	-8.5	3.9	3.9	0.354	0.461	0	6.8	18.3	42.3	16	2.31	0.37
70	-8.1	-8.1	6.5	6.6	0.589	0.552	0	12.1	21	75.4	16	3.59	0.58
80	-5.3	-5.3	10.3	10.4	0.934	0.929	0	21.4	15.5	178.7	12	11.53	1.38

FX HH0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	18.6	18.6	8.2	8.3	0.744	13.051	0	4.2	11.1	60.5	7	5.45	0.38
10	-12	-12	5	5	0.454	0.326	0	22.8	22.4	113.8	20	5.08	1.02
20	-16.1	-16.1	4.2	4.2	0.381	0.195	0	6.6	23.7	32.9	20	1.39	0.28
30	-18.7	-18.7	4.9	4.9	0.445	0.15	0	9.5	21	47.3	20	2.25	0.45
40	-21.1	-21.1	4.5	4.5	0.408	0.111	0	12.8	22.4	64.1	20	2.86	0.57
50	-23.8	-23.9	4.7	4.7	0.426	0.082	0	7.8	21	39.1	20	1.86	0.37
60	-26.4	-26.4	4.1	4.1	0.372	0.059	0	12.4	21	69.1	18	3.29	0.59
70	-31.4	-31.4	3.8	3.8	0.345	0.033	0	15.5	22.4	86	18	3.84	0.69
80	-39.8	-39.8	4.5	4.5	0.408	0.013	0	8.1	18.3	58	14	3.17	0.44

FX HV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
10	-19.8	-19.8	4.1	4.1	0.372	0.127	0	1.7	9.5	28.7	6	3.02	0.18
15	-22.1	-22.1	4.1	4.1	0.372	0.097	0	4.2	11.1	52.1	8	4.69	0.38
20	-22.5	-22.5	4.1	4.1	0.372	0.093	0	2.1	11.1	26.2	8	2.36	0.19
30	-24.1	-24.1	4.9	4.9	0.445	0.081	0	2.1	12.6	26.6	8	2.11	0.17
40	-26.6	-26.6	4.7	4.7	0.426	0.06	0	3.8	12.6	47.7	8	3.79	0.30
50	-29.6	-29.6	5.5	5.5	0.499	0.044	0	3.1	11.1	39.3	8	3.54	0.28
60	-31.7	-31.7	4.6	4.6	0.417	0.033	0	5.1	11.1	72.7	7	6.55	0.46
70	-34.6	-34.6	2.4	2.4	0.218	0.021	0	1	9.5	16.5	6	1.74	0.11

FX VV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	19.1	19.1	7.9	8	0.717	13.611	0	8.9	11.1	126.6	7	11.41	0.80
10	-12.9	-12.9	4.2	4.2	0.381	0.282	0	18.1	23.7	90.4	20	3.81	0.76
15	-18	-18	3.6	3.6	0.326	0.152	0	13.1	9.5	164.2	8	17.28	1.38
20	-15.5	-15.5	4	4	0.363	0.207	0	14.9	25	74.4	20	2.98	0.60
30	-17	-17	4.5	4.5	0.408	0.179	0	4.8	23.7	24.2	20	1.02	0.20
40	-18.5	-18.5	4.2	4.2	0.381	0.148	0	11.9	23.7	59.6	20	2.51	0.50
50	-20.3	-20.3	4.3	4.3	0.39	0.121	0	5.5	22.4	28.7	19	1.28	0.25
60	-22.1	-22.1	3.7	3.7	0.336	0.095	0	9.1	22.4	48.1	19	2.15	0.41
70	-25.1	-25.1	3.5	3.5	0.318	0.067	0	12.4	21	68.9	18	3.28	0.59
80	-31.8	-31.8	4.8	4.8	0.435	0.033	0	10.6	18.3	75.6	14	4.13	0.58

HC HH0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	7.6	7.6	4.4	4.4	0.399	3.017	0	72.4	55.8	37.1	195	0.66	1.30
10	-9.7	-9.7	4.4	4.4	0.399	0.412	0	53.5	48.6	45.8	117	0.94	1.10
20	-11.6	-11.6	4.2	4.2	0.381	0.327	0	58.6	53.4	28.7	204	0.54	1.10
30	-15.3	-15.3	4	4	0.363	0.212	0	33.2	43.8	28.4	117	0.65	0.76
50	-16.5	-16.5	4.9	4.9	0.444	0.193	0	88.6	61.7	33	268	0.53	1.44
70	-21.8	-21.8	4.1	4.1	0.372	0.101	0	131.3	48.6	81	162	1.67	2.70

HC VV3

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	7.2	7.2	4.7	4.7	0.436	2.897	0.03	90.2	55.8	56.7	159	1.02	1.62
10	-10	-10	3.9	3.9	0.409	0.357	0.03	53.4	46.2	46	116	1.00	1.16
20	-12.1	-12.1	4.5	4.5	0.499	0.282	0.03	41.3	53.4	26	159	0.49	0.77
30	-15.7	-15.7	3.6	3.6	0.433	0.167	0.03	21.5	45	18.4	117	0.41	0.48
50	-17.9	-17.9	4.6	4.6	0.634	0.129	0.03	108.7	53.4	60.4	180	1.13	2.04
70	-21.9	-21.9	4.1	4.1	0.739	0.065	0.03	37.3	47.4	31.1	120	0.66	0.79

IA HK AHH3

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	5.3	5.3	4.5	4.5	0.419	2.297	0.03	149.1	35.2	216.2	69	6.14	4.24
10	3	3	4.5	4.5	0.422	1.755	0.03	9.6	23.7	45.8	21	1.93	0.41
20	1.1	1.1	3.5	3.5	0.33	1.332	0.03	76.1	37.7	111.8	68	2.97	2.02
30	1.1	1.1	5.4	5.4	0.514	1.473	0.03	17.7	21	88.4	20	4.21	0.84
50	-1.1	-1.1	4.5	4.5	0.431	1.083	0.03	116	52.2	73.9	157	1.42	2.22
70	-4.8	-4.8	4	4	0.393	0.678	0.03	33.7	38.9	51.8	65	1.33	0.87

IA HK AHV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-3.3	-3.3	3.4	3.4	0.308	0.816	0	1.5	14.1	15.3	10	1.09	0.11
10	-6.3	-6.3	6.3	6.4	0.571	0.672	0	2.5	11.1	35.6	7	3.21	0.23
20	-6.1	-6.1	5.6	5.6	0.508	0.663	0	6.4	11.1	90.8	7	8.18	0.58
30	-5.5	-5.5	5.8	5.8	0.526	0.718	0	2.8	11.1	40.3	7	3.63	0.25
40	-7.9	-7.9	3.5	3.5	0.317	0.483	0	68.7	37.7	92.9	74	2.46	1.82
50	-9.8	-9.8	2.7	2.7	0.245	0.373	0	32	26.3	68.1	47	2.59	1.22
60	-10.7	-10.7	5.3	5.3	0.481	0.385	0	4	9.5	67.5	6	7.11	0.42
70	-14.8	-14.8	7	7.1	0.635	0.262	0	2	9.5	32.9	6	3.46	0.21

IA HK AVV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	4	4	4.4	4.4	0.399	1.993	0	140.5	41.3	184.9	76	4.48	3.40
5	2.8	2.8	5.3	5.3	0.481	1.83	0	10.1	12.6	67.1	15	5.33	0.80
10	1.1	1.1	6.1	6.2	0.554	1.56	0	14.5	23.7	60.6	24	2.56	0.61
20	0.3	0.3	4.3	4.4	0.394	1.298	0	58.4	43.8	83.5	70	1.91	1.33
25	0.2	0.2	4.7	4.7	0.426	1.303	0	12.1	12.6	121.2	10	9.62	0.96
30	-0.2	-0.2	5.7	5.7	0.514	1.313	0	23.9	23.7	103.8	23	4.38	1.01
40	-1.7	-1.7	4.2	4.2	0.381	1.023	0	47.3	32.7	124.4	38	3.80	1.45
45	-2.6	-2.6	2.4	2.4	0.214	0.834	0	3.5	9.5	58	6	6.11	0.37
50	-3.6	-3.6	0.5	0.5	0.046	0.68	0	8202.6	12.6	6835.5	120	542.50	651.00
70	-5.1	-5.1	3.8	3.8	0.345	0.678	0	57.7	37.7	84.8	68	2.25	1.53

IA HK UHV5

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	1.5	1.5	4.3	4.4	0.427	1.442	0.05	81.6	49.8	47.7	171	0.96	1.64
10	-5.6	-5.6	2.7	2.7	0.278	0.553	0.05	34.8	30.1	48.3	72	1.60	1.16
20	-10.4	-10.4	3.8	3.8	0.447	0.316	0.05	57.6	49.8	33.3	173	0.67	1.16
40	-13.7	-13.7	2	2	0.252	0.179	0.05	36.9	26.3	43.4	85	1.65	1.40
50	-15	-15	3.6	3.6	0.519	0.161	0.05	174	49.8	57.4	303	1.15	3.49
60	-18.2	-18.2	2.8	2.8	0.498	0.09	0.05	4.1	12.6	46	9	3.65	0.33
70	-18.5	-18.5	4.2	4.2	0.85	0.089	0.05	37.4	47.4	23	163	0.49	0.79

IA HK	Mean UVV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	10.3	10.3	3.8	3.8	0.345	3.991	0	69.1	45	40.2	172	0.89	1.54
10	-2	-2	3.2	3.2	0.29	0.938	0	42.6	36.4	54.6	78	1.50	1.17
20	-3.8	-3.8	3	3	0.272	0.755	0	27.1	41.3	15.8	172	0.38	0.66
30	-5.6	-5.6	4	4	0.363	0.647	0	35.3	38.9	45.2	78	1.16	0.91
40	-12.3	-12.3	1.4	1.4	0.127	0.261	0	2.1	9.5	26.6	8	2.80	0.22
50	-8.6	-8.6	3.3	3.3	0.299	0.441	0	100.7	41.3	45.5	221	1.10	2.44
60	-13.1	-13.1	4.6	4.6	0.417	0.281	0	7	16.9	58	12	3.43	0.41
70	-11.7	-11.7	3.2	3.2	0.29	0.307	0	74.5	42.6	42.1	177	0.99	1.75
80	-20	-20	4	4	0.363	0.123	0	1.7	7.8	34.8	5	4.46	0.22

IA HL	Mean HH0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	6.4	6.4	4.1	4.1	0.372	2.587	0	41.8	46.2	33.2	126	0.72	0.90
10	-8.7	-8.7	4.6	4.6	0.417	0.467	0	29.8	42.6	49.6	60	1.16	0.70
20	-16.5	-16.5	5.5	5.5	0.499	0.199	0	79.4	51	90.3	88	1.77	1.56
30	-22	-22	4	4	0.363	0.098	0	22.1	38.9	36.9	60	0.95	0.57
50	-23.6	-23.6	4.1	4.1	0.372	0.082	0	51.5	48.6	40.3	128	0.83	1.06
70	-30.3	-30.3	3.1	3.1	0.281	0.036	0	38.1	33.9	50.8	75	1.50	1.12

IA HL	Mean VV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	5.7	5.7	4	4	0.363	2.374	0	33.2	46.2	31.3	106	0.68	0.72
10	-8.4	-8.4	4.9	4.9	0.445	0.491	0	17.9	43.8	29.8	60	0.68	0.41
20	-14.7	-14.7	5.2	5.2	0.472	0.241	0	38.3	51	37.6	102	0.74	0.75
30	-22.1	-22.1	3.6	3.6	0.327	0.095	0	23.7	36.4	40.1	59	1.10	0.65
50	-23.8	-23.8	4.4	4.4	0.399	0.081	0	72	46.2	73.5	98	1.59	1.56
70	-29.5	-29.6	3.5	3.5	0.318	0.04	0	36.8	40.1	40	92	1.00	0.92

IA HS	Mean HH3	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	7.4	7.4	3.2	3.2	0.295	2.739	0.03	37.8	40.1	30.3	125	0.76	0.94
10	-9.3	-9.3	3.4	3.4	0.35	0.379	0.03	29.5	36.4	49.1	60	1.35	0.81
20	-13	-13	3.4	3.4	0.376	0.236	0.03	36.8	42.6	29	127	0.68	0.86
30	-17.1	-17.1	3.6	3.6	0.458	0.137	0.03	39.2	38.9	65.3	60	1.68	1.01
50	-19.1	-19.1	4	4	0.575	0.104	0.03	77.7	49.8	46.5	167	0.93	1.56
70	-26.8	-26.8	2.3	2.3	0.785	0.019	0.03	30.1	28.9	27.9	108	0.97	1.04

IA HS	Mean HV0	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-11.1	-11.1	4.5	4.5	0.408	0.352	0	47.7	42.6	67.2	71	1.58	1.12
10	-22.4	-22.4	4.2	4.2	0.381	0.094	0	28	38.9	50.9	55	1.31	0.72
20	-24.5	-24.5	3.7	3.7	0.336	0.072	0	40.3	42.6	38	106	0.89	0.95
30	-27.4	-27.4	3	3	0.272	0.05	0	25.8	32.7	43.8	59	1.34	0.79
50	-29.7	-29.7	3.4	3.4	0.308	0.039	0	78	40.1	67.3	116	1.68	1.95
70	-35.3	-35.3	3	3	0.272	0.02	0	43.8	32.7	51	86	1.56	1.34

HS VV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	7.5	7.5	3.4	3.4	0.308	2.83	0	29.2	37.7	27.8	105	0.74	0.77
10	-8.8	-8.8	3.3	3.3	0.299	0.431	0	23.1	35.2	38.5	60	1.09	0.66
20	-12.4	-12.4	3.2	3.2	0.29	0.283	0	45.4	37.7	42.5	107	1.13	1.20
30	-16.5	-16.5	3.1	3.1	0.281	0.176	0	21.9	31.4	36.6	60	1.17	0.70
50	-19.8	-19.8	3.1	3.1	0.281	0.12	0	57.7	38.9	47.7	121	1.23	1.48
70	-26	-26	2.1	2.1	0.191	0.056	0	15.7	28.9	14.5	108	0.50	0.54

HW HH0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	4.1	4.1	4.3	4.3	0.39	2.006	0	2.2	7.8	43.2	5	5.54	0.28
40	2.8	2.8	2.4	2.4	0.218	1.565	0	15.9	21	44.3	36	2.11	0.76
60	-0.8	-0.8	4	4	0.359	1.121	0	0.1	7.8	1.8	5	0.23	0.01
70	-3.3	-3.3	3.8	3.8	0.345	0.834	0	0.1	7.8	2.4	5	0.31	0.01

HW HV0

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
35	-5.4	-5.4	1.3	1.3	0.118	0.575	0	2.6	9.5	37.2	7	3.92	0.27
45	-6.1	-6.1	2.6	2.6	0.236	0.567	0	9.6	14.1	79.6	12	5.65	0.68
55	-8.2	-8.2	4	4	0.363	0.479	0	12.3	15.5	94.4	13	6.09	0.79
65	-11.8	-11.8	4.7	4.7	0.426	0.328	0	6.7	16.9	56	12	3.31	0.40
75	-15.8	-15.8	3.8	3.8	0.345	0.198	0	11.4	16.9	71.5	16	4.23	0.67

HX HV3

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	-0.8	-0.8	3.1	3.1	0.293	1.041	0.03	2.6	12.6	28.9	9	2.29	0.21
20	-11.9	-11.9	2.3	2.3	0.243	0.256	0.03	13.4	28.9	19.4	69	0.67	0.46
30	-14.7	-14.7	3.4	3.4	0.394	0.189	0.03	9.9	23.7	49.6	20	2.09	0.42
40	-13.8	-13.8	2.7	2.7	0.3	0.204	0.03	46.9	25	104.3	45	4.17	1.88
50	-17.4	-17.4	2.3	2.3	0.284	0.121	0.03	22.7	32.7	18.9	120	0.58	0.69
70	-22.2	-22.2	2.8	2.8	0.479	0.058	0.03	32.6	33.9	45.9	71	1.35	0.96

HX VV5

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	9.3	9.3	3.7	3.7	0.344	3.487	0.05	36.1	36.4	49.4	73	1.36	0.99
10	-3.8	-3.8	2.6	2.6	0.261	0.689	0.05	16.2	26.3	56	29	2.13	0.62
20	-5.3	-5.3	2.6	2.6	0.266	0.571	0.05	23.6	32.7	31.9	74	0.98	0.72
30	-9.8	-9.8	2.6	2.6	0.291	0.32	0.05	8.2	23.7	29.4	28	1.24	0.35
40	-11.8	-11.8	2.9	2.9	0.348	0.248	0.05	7.4	15.5	57.1	13	3.68	0.48
50	-12.6	-12.6	2.4	2.4	0.293	0.215	0.05	22.2	30.1	24.1	92	0.80	0.74
60	-15	-15	4.4	4.4	0.659	0.168	0.05	9.1	18.3	60.8	15	3.32	0.50
70	-16.3	-16.3	3	3	0.458	0.127	0.05	52	37.7	66.7	78	1.77	1.38
80	-22.8	-22.8	4.2	4.2	1.985	0.018	0.05	4.7	11.1	52	9	4.68	0.42

IK AHH3

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
0	3.6	3.6	6.4	6.4	0.607	2.083	0.03	53	47.4	110.4	48	2.33	1.12
10	-2.7	-2.7	8.6	8.6	0.884	1.116	0.03	13.8	23.7	69.1	20	2.92	0.58
25	-5	-5	8.7	8.7	0.926	0.851	0.03	4.3	14.1	43.2	10	3.06	0.30
30	-4.4	-4.4	9.7	9.7	1.045	0.964	0.03	19.7	25	98.3	20	3.93	0.79
50	-8.5	-8.5	8.2	8.2	0.922	0.541	0.03	85.4	74.5	74.9	114	1.01	1.15
70	-9.8	-9.8	8.3	8.3	0.966	0.461	0.03	51.5	48.6	103	50	2.12	1.06

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
IK	AHV0												
0	-17.5	-17.5	10	10.1	0.907	0.225	0	11.6	14.1	128.8	9	9.13	0.82
10	-26.5	-26.5	5.4	5.4	0.49	0.063	0	1.9	7.8	38.7	5	4.96	0.24
20	-25.6	-25.6	3.7	3.7	0.336	0.064	0	2	9.5	33	6	3.47	0.21
50	-27.6	-27.6	1.8	1.8	0.163	0.046	0	10.1	16.9	34.8	29	2.06	0.60
60	-31.6	-31.6	1.8	1.8	0.163	0.029	0	4.4	7.8	72.7	6	9.32	0.56
80	-39.6	-39.6	6.8	6.9	0.617	0.015	0	0	-1	0	3	0.00	0.00

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
IK	UHV3												
0	2.4	2.4	4.8	4.8	0.452	1.662	0.03	121.2	52.2	68.8	176	1.32	2.32
10	-6.9	-6.9	4	4	0.402	0.526	0.03	57.7	40.1	68.6	84	1.71	1.44
20	-12.9	-12.9	5.2	5.2	0.601	0.264	0.03	103.7	55.8	52.6	197	0.94	1.86
30	-16.2	-16.2	6.1	6.1	0.817	0.177	0.03	215	43.8	238.9	90	5.45	4.91
50	-19.2	-19.2	6.4	6.4	1.044	0.113	0.03	126.9	68.7	45.6	278	0.66	1.85
70	-20.4	-20.4	5.8	5.8	1.007	0.09	0.03	49.7	62.8	28.7	173	0.46	0.79

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
IK	UVV3												
0	8.5	8.5	5	5	0.463	3.423	0.03	117.4	52.2	69.9	168	1.34	2.25
10	-3.2	-3.2	4.2	4.2	0.407	0.83	0.03	58.1	42.6	63.9	91	1.50	1.36
20	-6.6	-6.6	4.7	4.7	0.475	0.566	0.03	58.2	51	33.8	172	0.66	1.14
30	-7.5	-7.5	5.2	5.2	0.536	0.522	0.03	52	46.2	57.7	90	1.25	1.13
50	-11.2	-11.2	4.9	4.9	0.538	0.324	0.03	71	56.9	34	209	0.60	1.25
70	-13.2	-13.2	3.9	3.9	0.438	0.237	0.03	45.7	48.6	27.5	166	0.57	0.94

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
IW	HV0												
0	-3.2	-3.2	5.5	5.5	0.499	0.922	0	4.1	12.6	45.1	9	3.58	0.33
10	-9.3	-9.3	2.1	2.1	0.19	0.382	0	3.3	11.1	36.4	9	3.28	0.30
20	-9.8	-9.8	2.4	2.4	0.218	0.367	0	5.7	11.1	63.5	9	5.72	0.51
30	-10.1	-10.1	2.5	2.5	0.227	0.356	0	4.6	11.1	50.8	9	4.58	0.41
50	-13.5	-13.5	4.3	4.3	0.39	0.264	0	0.9	15.5	7.1	12	0.46	0.06
60	-15.4	-15.4	5.4	5.4	0.49	0.225	0	4.7	16.9	38.9	12	2.30	0.28

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/ OACHI	TS/ OACHI
IW	VV0												
0	0.2	0.2	5.7	5.8	0.518	1.378	0	0.8	12.6	8.3	10	0.66	0.06
5	-7.3	-7.3	2.5	2.5	0.227	0.492	0	3.3	12.6	33.3	10	2.64	0.26
10	-6.9	-6.9	3	3	0.272	0.528	0	7.4	14.1	67.4	11	4.78	0.52
20	-7.2	-7.2	3.3	3.3	0.299	0.518	0	6.4	15.5	46	14	2.97	0.41
30	-8.7	-8.7	3.7	3.7	0.336	0.445	0	3.9	16.9	28	14	1.66	0.23
35	-10.2	-10.2	2.5	2.5	0.227	0.352	0	9.3	15.5	71.6	13	4.62	0.60
45	-10.7	-10.7	3.8	3.8	0.345	0.356	0	17.3	22.4	91.1	19	4.07	0.77
50	-11	-11	3.2	3.2	0.29	0.333	0	7.5	15.5	57.5	13	3.71	0.48
55	-12.4	-12.4	2.9	2.9	0.263	0.279	0	12	21	60.2	20	2.87	0.57
60	-14.2	-14.2	3.4	3.4	0.308	0.233	0	4	15.5	30.8	13	1.99	0.26
65	-15.4	-15.4	1.8	1.8	0.163	0.186	0	7.5	16.9	53.5	14	3.17	0.44
75	-18	-18	5.3	5.3	0.481	0.166	0	19	21	86.3	22	4.11	0.90

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/	TS/
IX	HH3											OACHI	OACHI
0	3.5	3.5	3.9	3.9	0.364	1.802	0.03	1410.9	41.3	1396.9	101	33.82	34.16
10	-7.6	-7.6	3.9	3.9	0.395	0.48	0.03	78.9	33.9	213.1	37	6.29	2.33
20	-10.6	-10.6	3.4	3.4	0.357	0.322	0.03	40.6	43.8	36.5	111	0.83	0.93
30	-15.2	-15.2	3.4	3.4	0.4	0.176	0.03	21.8	31.4	60.5	36	1.93	0.69
40	-17	-17	3.6	3.6	0.456	0.139	0.03	16.8	33.9	44.3	38	1.31	0.50
50	-18	-18	3.4	3.4	0.448	0.119	0.03	62.1	47.4	26.3	236	0.55	1.31
60	-21.8	-21.8	5.4	5.4	1.039	0.069	0.03	15.3	21	95.9	16	4.57	0.73
70	-20	-20	4.3	4.3	0.665	0.092	0.03	29.8	47.4	34.3	87	0.72	0.63

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/	TS/
IX	HV3											OACHI	OACHI
0	0.9	0.9	3	2.9	0.273	1.262	0.03	33.6	30.1	62.3	54	2.07	1.12
10	-12.6	-12.6	2	2	0.213	0.23	0.03	8.6	16.9	43.1	20	2.55	0.51
20	-15.5	-15.5	3.3	3.3	0.391	0.168	0.03	36.2	36.4	45.9	79	1.26	0.99
30	-18.2	-18.2	2.1	2.1	0.266	0.107	0.03	11.3	22.4	41.7	27	1.86	0.50
40	-23.3	-23.3	2.5	2.5	0.467	0.047	0.03	22.7	25	78.3	29	3.13	0.91
50	-22.5	-22.5	3.5	3.5	0.644	0.057	0.03	39.6	41.3	32.7	121	0.79	0.96
60	-26.7	-26.7	4.8	4.8	2	0.014	0.03	2.2	11.1	27.3	8	2.46	0.20
70	-24.2	-24.2	4.1	4.1	0.976	0.04	0.03	52.6	40.1	69.2	76	1.73	1.31

IA	Mean	ResMean	StD	ResStD	Alpha	Beta	Gamma	TstStat	OAChi	NormTS	N	NTS/	TS/
IX	VV3											OACHI	OACHI
0	2.8	2.8	3.7	3.7	0.346	1.643	0.03	983.4	37.7	1385.1	71	36.74	26.08
10	-6.9	-6.9	4.1	4.1	0.412	0.529	0.03	74.9	30.1	214.1	35	7.11	2.49
20	-9.4	-9.4	4.4	4.4	0.461	0.395	0.03	59.3	43.8	81.2	73	1.85	1.35
30	-14.8	-14.8	3.6	3.6	0.421	0.188	0.03	26.4	32.7	80	33	2.45	0.81
40	-18.7	-18.7	4.4	4.4	0.629	0.113	0.03	4.5	18.3	34.7	13	1.90	0.25
50	-16.4	-16.4	3.9	3.9	0.487	0.154	0.03	28.8	43.8	28.5	101	0.65	0.66
60	-20.1	-20.1	6.1	6.1	1.049	0.096	0.03	11.1	21	74.2	15	3.53	0.53
70	-18.8	-18.8	4.2	4.2	0.599	0.11	0.03	35.4	47.4	46	77	0.97	0.75

Bibliography

1. Champion, I, "Simple Modeling of Radar Backscattering Coefficient Over a Bare Soil: Variation with Incidence Angle, Frequency, and Polarization," International Journal of Remote Sensing, 17: 783-800 (1996)

2. Champion, I, D. Guyon, J. Riom, T. Le Toan and A. Beaudoin. "Effect of Forest Thinning on the Radar Backscattering Coefficient at L-Band," International Journal of Remote Sensing, 19: 2233-2238 (1998)

3. Devore, Jay L. Probability and Statistics for Engineering and the Sciences (Fourth Edition). Belmont: Duxbury Press, 1995.

4. Dong, Y, B. Forster, and C. Ticehurst. "Radar Backscatter Analysis for Urban Environments," International Journal of Remote Sensing, 18: 1351-1364 (1997)

5. Harnett, Donald Statistical Methods (Third Edition). Reading: Addison-Wesley Publishing Co., 1991

6. Rombach, M, A. Demircan, and W. Mauser. "Correlation Between Soil Moisture and the Backscattering Coefficient of ERS-1 Data," Proceedings Second ERS-1 Symposium-Space at the Service of Our Environment. 861-864. Paris: European Space Agency, 1994.

7. Skolnik, Merril. Radar Handbook (Second Edition). New York: McGraw-Hill Book Company, 1990.

8. Ulaby, Fawwaz T. and M. Craig Dobson. Handbook of Radar Scattering Statistics for Terrain. Norwood: Artech House, 1989.

9. Ulaby, Fawwaz T, Pascale C. Dubois, and Jakob van Zyl. "Radar Mapping of Surface Soil Moisture," Journal of Hydrology, 184: 57-84 (1996)

10. Ulaby, Fawwaz T. and C. Elachy. Radar Polarimetry for Geoscience Applications. Norwood: Artech House, 1990.

11. Wilson, Kelce Effects of Clutter Height Distributions on Adaptive Clutter Erasure Performance. Air Force Institute of Technology (AU), Wright-Patterson AFB OH, May 1998

Vita

Second Lieutenant Ricardo Mediavilla was born on 8 April 1974 in Santurce, Puerto Rico. He graduated from Dr. José M. Lázaro High School in Carolina, Puerto Rico in May 1992. He entered undergraduate studies at the University of Puerto Rico, Mayaguez Campus where he graduated Magna Cum Laude with a Bachelor of Science degree in Electrical Engineering in June 1997. He was commissioned through the Detachment 755-A AFROTC at the Mayaguez Campus of the University of Puerto Rico. Lt. Mediavilla was accepted to AFIT after completing his undergraduate studies.

Lt. Mediavilla married Paola Chardon on 26 of December 1998. Upon graduation, Lt. and Mrs. Mediavilla will move to Utah. Lt Mediavilla has been assigned to the Radar Evaluation Squadron (RADES/TOE), Hill AFB, Utah.

Permanent address: Urb. Vistamar
Gerona ST #615
Carolina, PR 00983